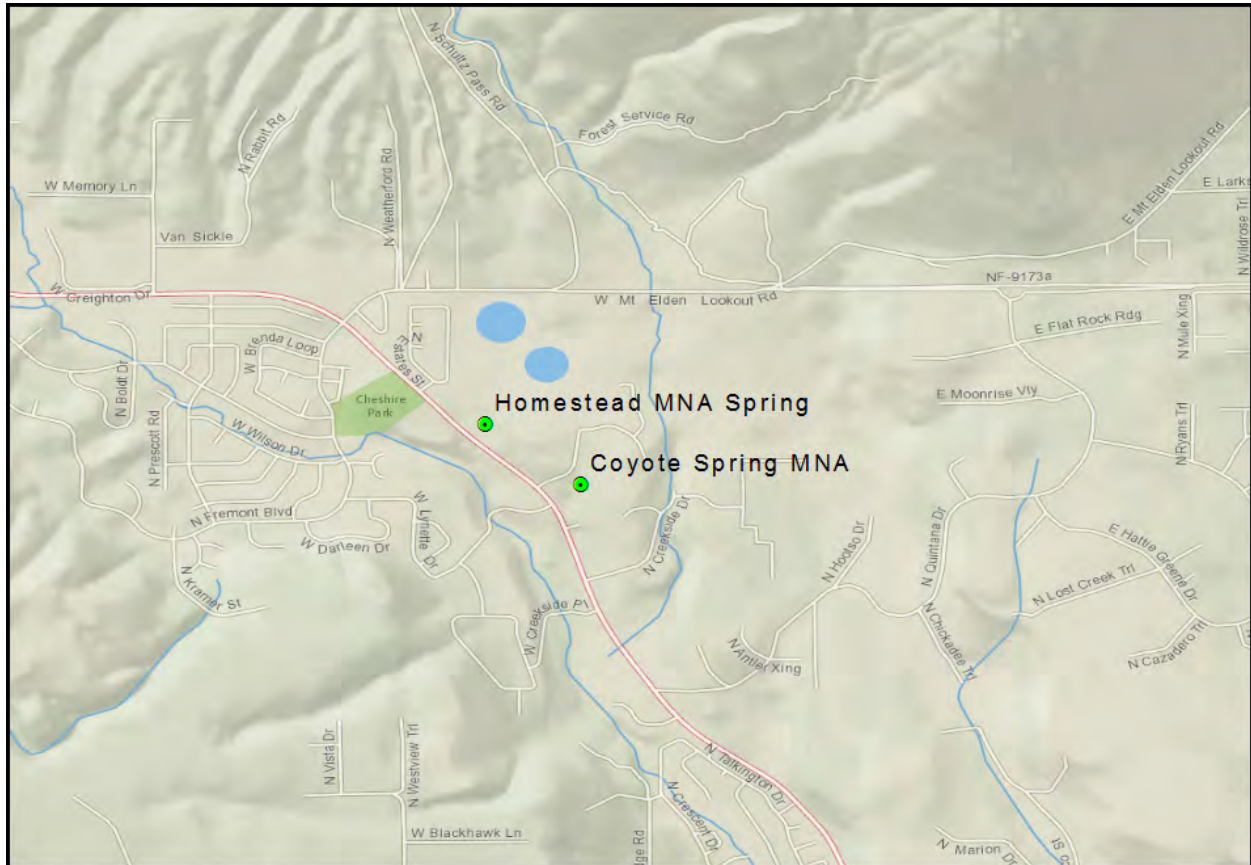


# Springs Stewardship Institute

Springs Online Geodatabase Export



**SPRINGS STEWARDSHIP INSTITUTE**

*a GLOBAL INITIATIVE of the MUSEUM of NORTHERN ARIZONA*

Museum of Northern Arizona  
3101 North Fort Valley Road  
Flagstaff, AZ, 86001, United States  
(928) 774-5211 ext. 231

<http://springstewardshipinstitute.org/>

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## Introduction:

This geodatabase contains a subset of springs and survey data exported from the Springs Online database (<http://springsdata.org/>). For more information regarding data compilation methods and a description of the database see <http://springstewardshipinstitute.org/database-manual-1/>. These data are a snapshot only; more current information is available at Springs Online. Contact the Springs Stewardship Institute for a more recent export.

The geodatabase contains a single feature class of spring point locations and several tables of related site and survey data. These data were compiled by the Springs Stewardship Institute, although survey data may have been collected by other entities.

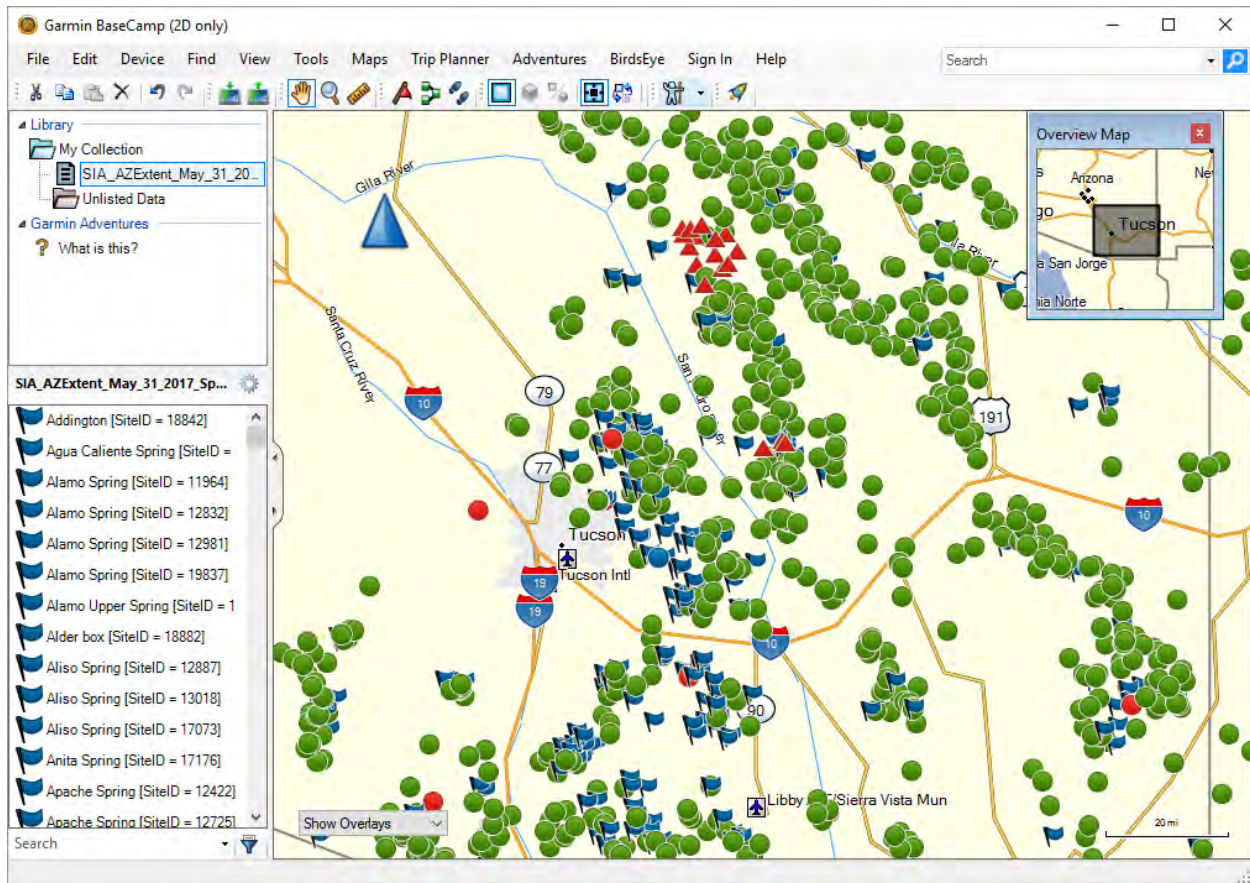
All data may be accessed and analyzed from within ArcGIS by loading the Springs point feature class. All additional tables are connected to the Springs feature class, so that querying or selecting one or more springs allows you to automatically see and analyze all information related to those springs. This document will explain how to view and use the Springs feature class and related tables.

## GPX File:

There should be a GPX file of spring locations included with the geodatabase, named with the same name as your Springs feature class and appended with the extension "GPX". If you would like to enter all your spring locations into a handheld GPS device, then this GPX file should help.

GPX files are designed to hold spatial data in a standardized format that allows them to be imported and exported from multiple GPS devices. SSI recommends Garmin's "BaseCamp" software (see <http://www.garmin.com/en-US/shop/downloads/basecamp>) as a handy and free tool for viewing GPX files on your computer, and for uploading and downloading from GPS devices.





### Using the Geodatabase:

Begin by loading the Springs point feature class using either the Springs Layer file or the actual springs feature class in the geodatabase. Both options load the same data; the only difference is that the Layer file loads the data automatically symbolized by *Inventory Level*, so you can easily see which springs have been confirmed and/or surveyed.

Please note that the names of the geodatabase and of the Springs point feature class will change depending which springs are exported and when the export occurred, so your Springs point feature class and geodatabase probably won't have the same name as the illustrations in this manual. However, all internal and related tables will be named the same as those illustrated here:

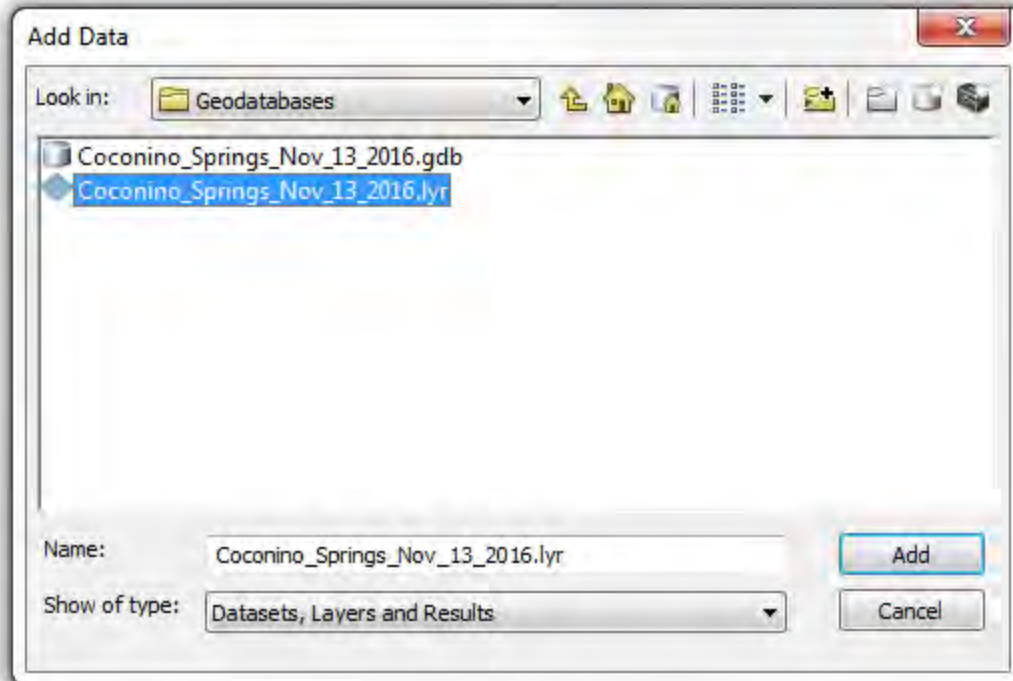


Figure 1: Loading the Springs Feature Class using the Layer file.

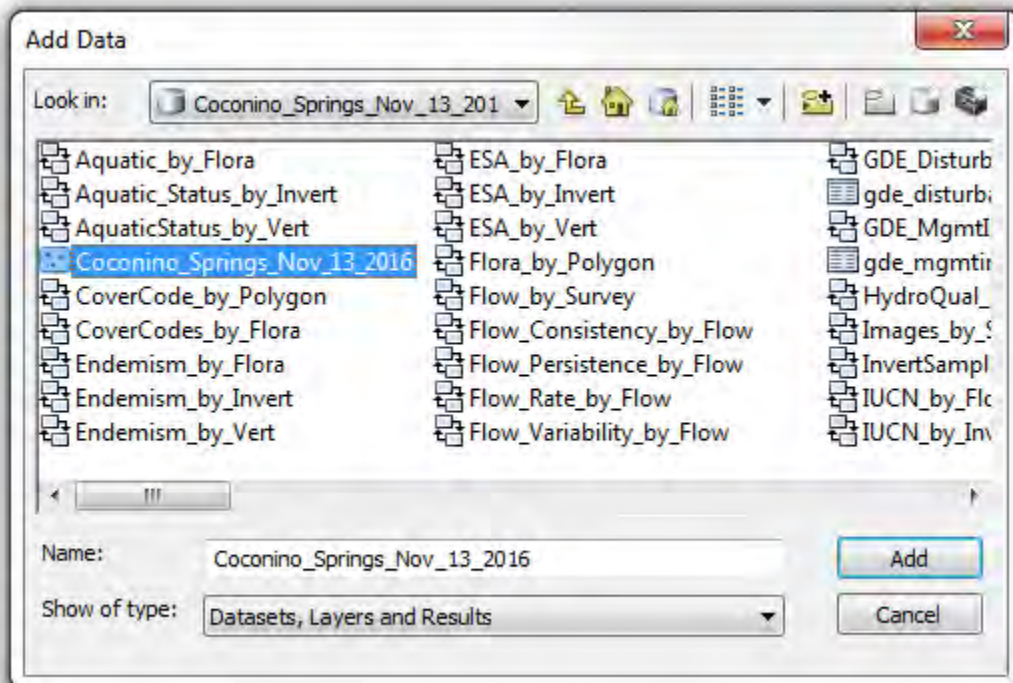


Figure 2: Loading the Springs Feature Class directly from the geodatabase.



If you wish, you may also load any of the additional geodatabase tables manually into ArcMap. This step is not necessary for most analyses, but you may be interested in reviewing individual datasets manually.

After you have loaded the Springs feature class, you may now do a number of things with it. Naturally you can make maps of the points, but we assume you have a basic understanding of GIS, ArcGIS and basic cartography so we will not describe general cartographic concepts nor how to make general maps of the springs. Nor will we discuss the standard ArcGIS analytical tools (proximity, buffering, etc.). These topics are better covered in an actual ArcGIS manual or class.

**Note:** If you would like a full set of introductory lessons and lectures on ArcGIS, please contact the Springs Stewardship Institute GIS Analyst Jeff Jenness ([jeffj@jennessent.com](mailto:jeffj@jennessent.com)), who teaches an introductory GIS course at the Northern Arizona University School of Forestry and is willing to share the lecture files.

However, there are a few cool things you can do specifically with this geodatabase, and which depend on the particular structure of the datasets. This document will walk you through a few common types of analyses, and the examples should serve as a guide to help you do similar analyses.

### Database Structure:

The Springs feature class is connected to 108 other tables through one or more ArcGIS relationship classes. These relationship classes provide links that let you view multiple layers of connected data.

#### For example: How Plant Species are connected to Spring Locations

The spring point feature itself has a variety of attributes that describe it, including name, elevation, survey status, various location designations, etc. Most spring attributes that are unlikely to change over time are saved directly in the Springs feature class.

Then, for each spring, one or more surveys may have been conducted. These surveys are stored in the **tbl\_Surveys** table, and include information on the survey date and time, surveyors, project, and various survey attributes recorded during that survey. This **tbl\_Surveys** is connected back to the Springs feature class so that all surveys done on a spring may be viewed by simply clicking on that spring.

Then, each survey may have analyzed topographic features, substrate types and species compositions within different regions of the spring area. These attributes are recorded in the table **tbl\_PolygonSurvey**, which is connected back to **tbl\_Surveys**.

Then, multiple plant species may have been recorded within each region of the spring area. These are all recorded in the table **tbl\_PolygonFlora**, which is connected back to **tbl\_PolygonSurvey**.

Then, each plant species may have extensive information regarding scientific and common name, conservation status, range, habitat, links to websites, etc. This detailed taxonomic data is stored in the table **tlu\_TaxaFlora**, which is connected back to the table **tbl\_PolygonSurvey**.

So, to get a list of plant species observed at a spring, ArcGIS simply connects from the Springs feature class through several levels of tables beginning with **tbl\_Surveys**, then to **tbl\_PolygonSurvey**, then to **tbl\_PolygonFlora**, and finally to **tlu\_TaxaFlora**. Fortunately you don't have to make these connections yourself because they are saved as relationship classes in the database.

The examples below (starting on p. 17) will walk you through some common types of analysis that take advantage of these connections, including how to identify all plant species observed at one or more springs, or how to identify all springs at which a plant species was observed. By stepping through these examples, you should also gain insight on how to do any similar type of analysis you wish.



The network of connections is complex, but all connections are diagrammed in Appendix B and in the poster **Springs\_Database\_Relationship\_Classes\_Poster.pdf**. All datasets are described in Appendix A.





## Metadata:

Extensive metadata are available for all datasets, including descriptions of the datasets and of all attribute fields. Metadata on any layer in ArcMap may be viewed by right-clicking the layer, then selecting “Data”, then “Item Description”:

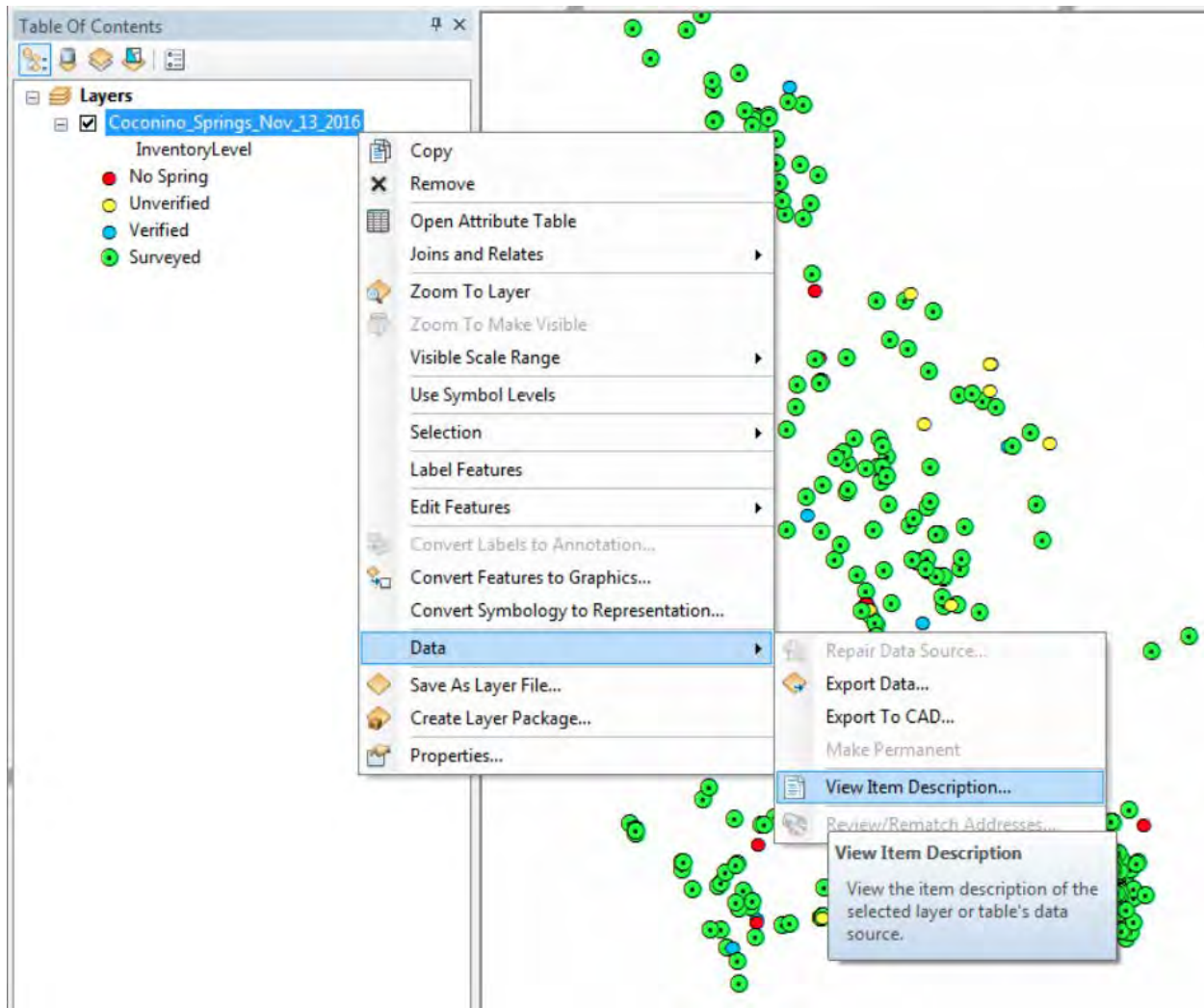


Figure 3: Getting to Metadata in ArcMap

You can also open metadata from the ArcMap Catalog view by right-clicking on the dataset and directly choosing “Item Description”.

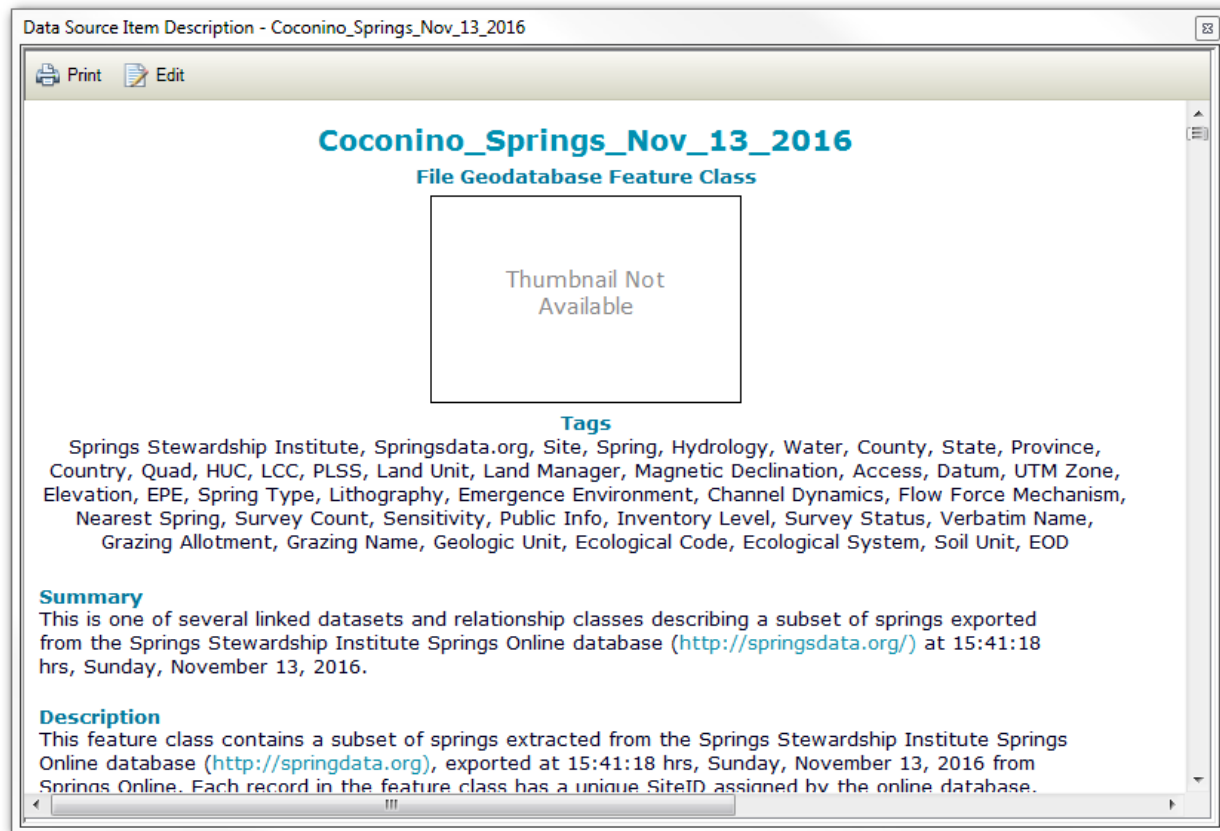


Figure 4: ArcMap metadata window

Some of the most helpful features of the metadata are the field attribute descriptions. Attribute field names and values are notorious for being obscure, and the metadata is often the only way to determine exactly what information a field contains. For example, if you review the survey data of a particular spring and find a plant species with a “DefaultWetlandStatus” value of “A”, and are not sure of what that means, then the metadata description for that field will tell you that “A” means the species “Occurs in standing water or underwater, rarely found outside standing or flowing water habitat”.

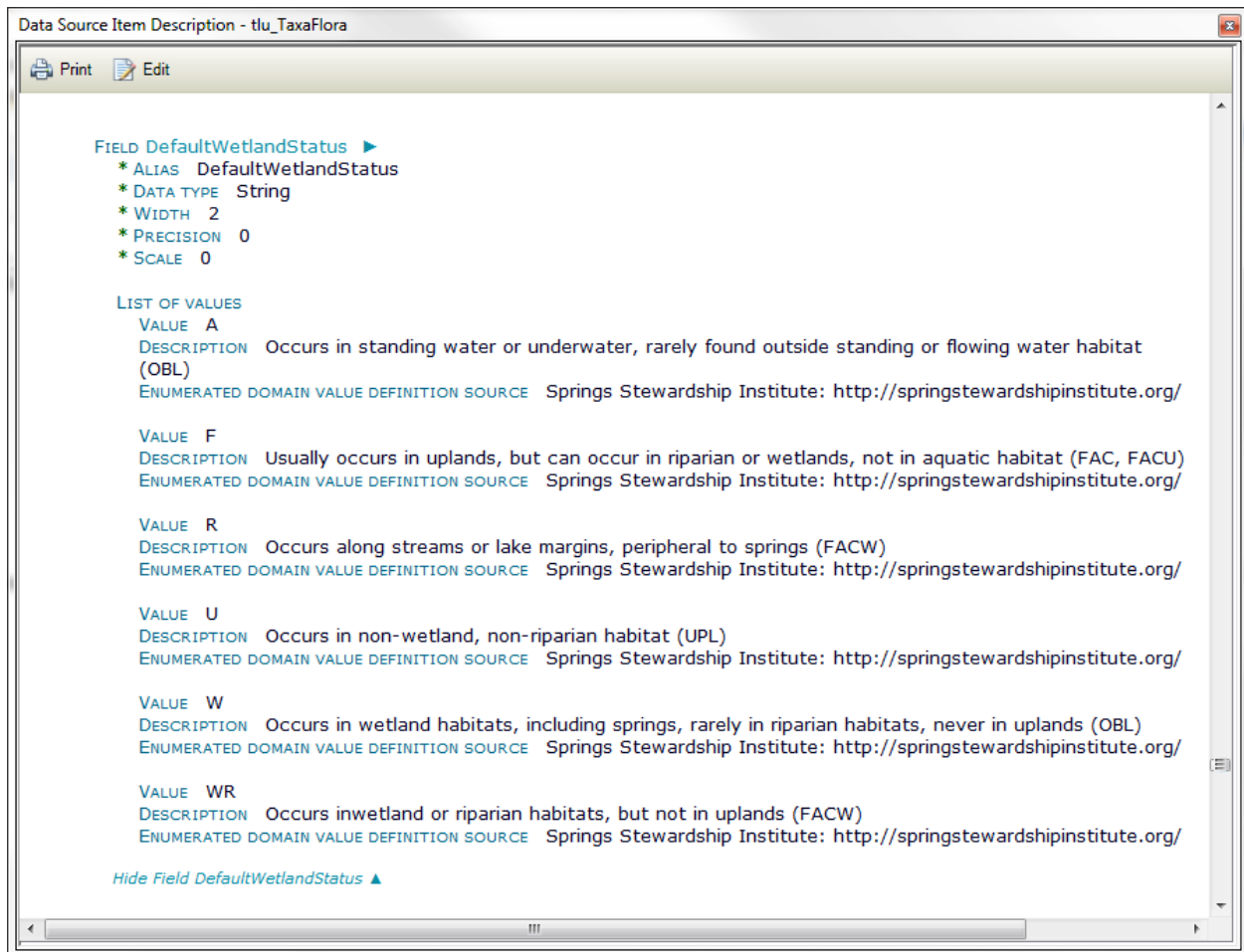


Figure 5: Field definition in metadata

**Note:** If you have never used ArcGIS to look at metadata before, then there is a good chance your installation of ArcMap is not set to show you the metadata of attribute fields. If you open the metadata and only see a few entries (tags, summary, description, credits, use limitations, extent and scale range), then you'll need to change your metadata style to anything other than *Item Description*. To do this, click the "Customize" menu, then "ArcMap Options". In the ArcMap Options window, select the "Metadata" tab and change the Metadata Style in the dropdown list:

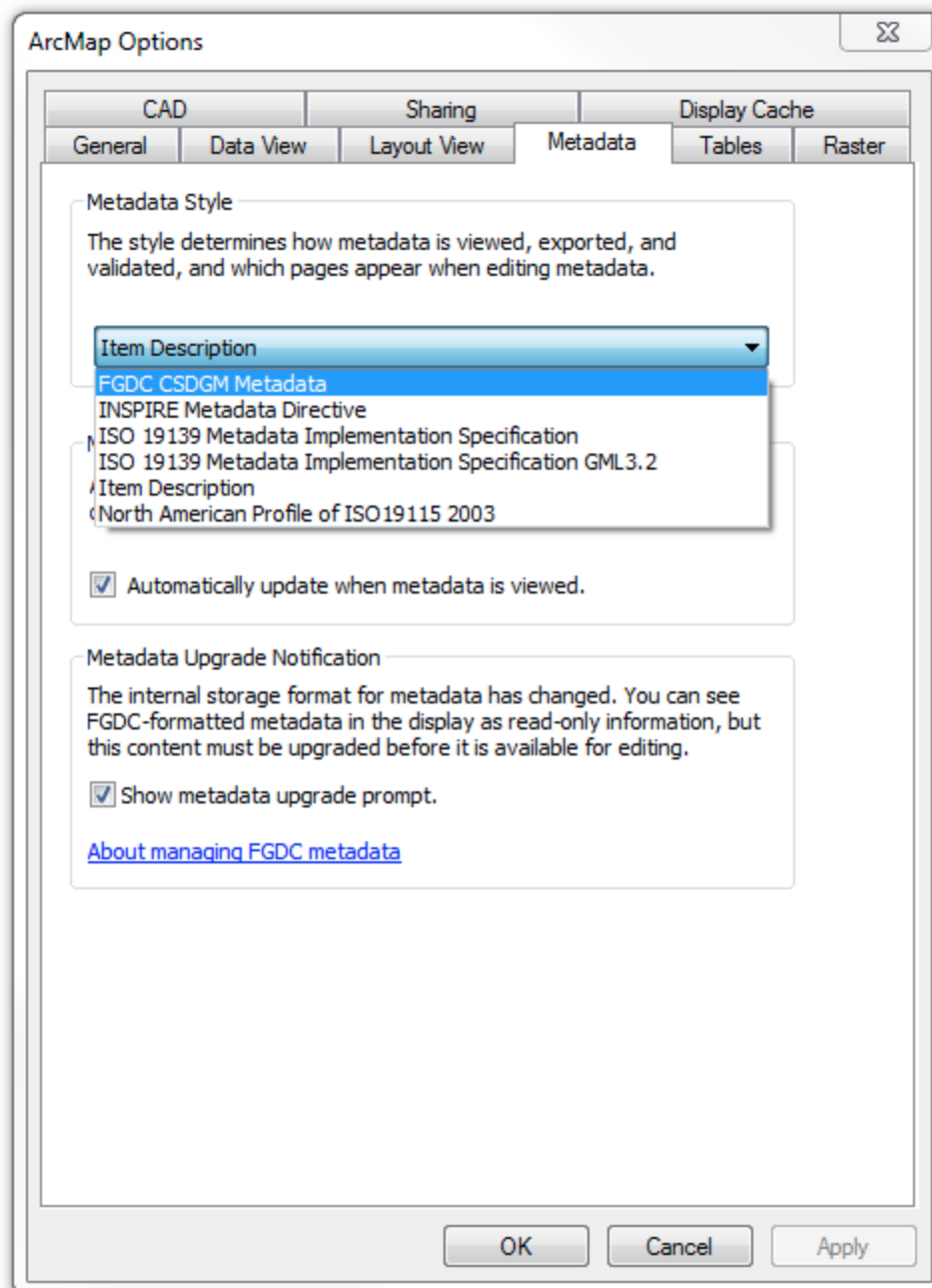


Figure 6: Resetting metadata style


Pretty much any option other than *Item Description* will be good.

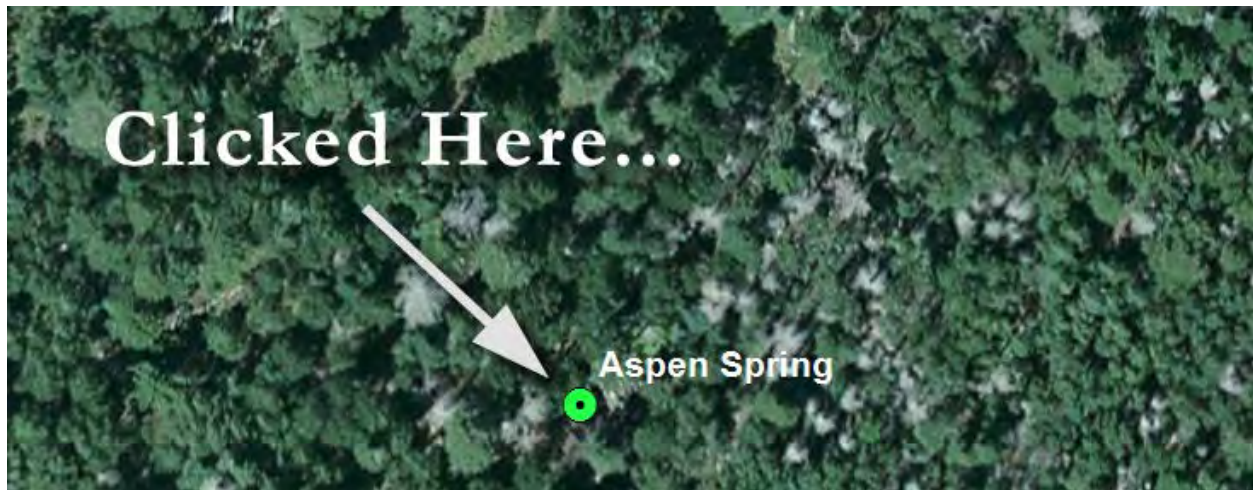




### Examples:

Viewing all data ever recorded at a single spring:

Spring attributes, plus all related data tables, are available from the “Identify” command  in ArcMap. Simply use the Identify command to click on a spring.



The “Identify” window will show all spring attributes from the Springs feature class. If any surveys have been conducted on that spring, then all survey data are available in nested links in the window. Please refer to Appendices A and B for descriptions of the datasets and diagrams of the dataset connections.



Identify

Identify from: [<Top-most layer>](#)

- Coconino\_Springs\_Nov\_13\_2016
  - Aspen Spring
    - tbl\_Surveys
      - Invertebrate survey by A. Hadley
        - tbl\_PolygonSurvey
        - tbl\_VertSurvey
        - tbl\_InvertSampling
          - Lepidoptera Nymphalidae Nymphalis antiopa
          - Lepidoptera Lycaenidae Callophrys spinetorum
          - Lepidoptera Lycaenidae Callophrys spinetorum

Location: -12,427,611.873 4,206,927.092 Meters

| Field               | Value   |
|---------------------|---|
| AKA                 | <null>  |
| AvgEOD              | 2.2   |
| AZ_NS               | N   |
| CastAccessDescript  | Hike up the Weatherford Trail from Schultz Tank, then go off the trail to the right in a drainage. This site is n   |
| CastDesignation     | <null>  |
| CastGeoref_Comments | <null>  |
| CastHUC_12          | <null>  |
| CastImageHyperlink  | <a href="http://springsdata.org/uploaded_files/survey/2146221007/2146221007_rep.jpg">http://springsdata.org/uploaded_files/survey/2146221007/2146221007_rep.jpg</a> |
| CastSiteDescription | This rheocrene emerges in a steep drainage in a heavily forested area on the San Francisco Peaks.   |
| CastSiteHyperlink   | <null>  |
| CastSketchHyperlink | <null>  |
| ChannelDynamics     | <null>  |
| Country             | US  |
| County              | Coconino  |
| Datum               | NAD83   |
| Ecol_Code           | <null>  |
| Ecol_System         | <null>  |
| Elev_Determined     | <null>  |
| ElevationM          | 2890  |

Identified 1 feature

Figure 7: Nested attribute tables available using the Identify command

Note that if there are any hyperlinks stored in the database (such as the “CastImageHyperlink” in the image above), then you may connect to those links simply by clicking on the item. These items are denoted with little lightning-bolt icons ⚡ on the right side of the window.



*Figure 8: Image accessed through a hyperlink in the Identify window*



### Identifying all invertebrate species recorded at a set of springs:

A common task is to identify all species found in one or more springs. Vertebrates and Invertebrates are organized differently than Flora species, so we present examples of each case.

Springs are connected to Invertebrates via a route through several tables. The Spring points are connected to **tbl\_Surveys**, which are then connected to **tbl\_InvertSampling**, and then to **tbl\_TaxaInvert**. ArcMap provides a simple way to select all species in **tbl\_TaxaInvert** based on an initial selection of springs (see Appendix B or the PDF file *Springs\_Database\_Relationship\_Classes\_Poster.pdf* for dataset connection diagrams). Do the following:

- 1) Select the springs you want to analyze. You can do this using any selection method you wish. In this example, we have selected all the springs on or near the San Francisco Peaks near Flagstaff, Arizona:

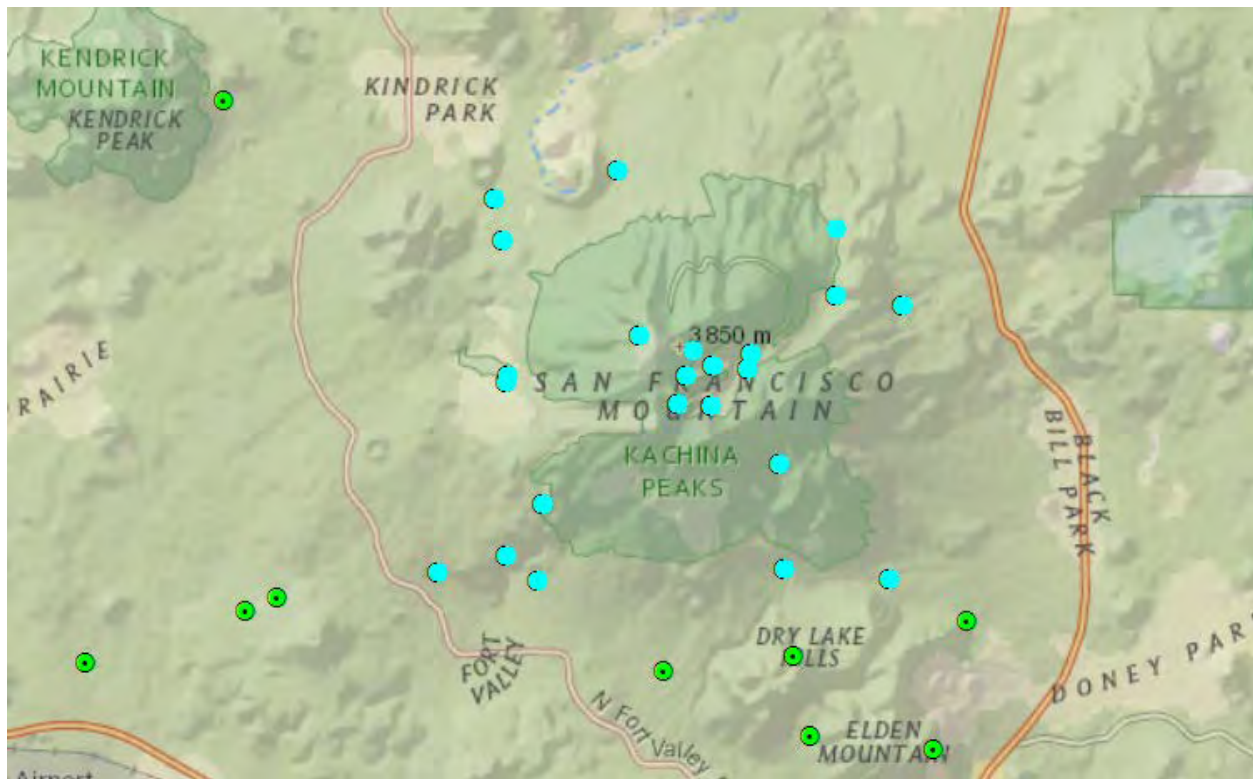


Figure 9: An initial selection of springs

- 2) Open the attribute table by right-clicking on the “Springs” layer in the table of contents and choosing “Open Attribute Table”. **Note:** You can also open attribute tables for selected layers and tables by hitting the [Control]-T keyboard shortcut.






Table

Coconino\_Springs\_Nov\_13\_2016

| OBJECTID * | SiteID * | SiteName                     | County   | StateProvince * | Countr |
|------------|----------|------------------------------|----------|-----------------|--------|
| 313        | 436      | Taylor Spring Humphreys Peak | Coconino | AZ              | US     |
| 322        | 446      | Viet Spring                  | Coconino | AZ              | US     |
| 405        | 542      | Aspen Spring                 | Coconino | AZ              | US     |
| 631        | 803      | Little Leroux Spring         | Coconino | AZ              | US     |
| 632        | 804      | Orion Spring                 | Coconino | AZ              | US     |
| 634        | 806      | Big Leroux Spring            | Coconino | AZ              | US     |
| 707        | 889      | Alto Spring                  | Coconino | AZ              | US     |
| 715        | 897      | Beard Spring                 | Coconino | AZ              | US     |
| 716        | 898      | Bear Jaw Spring              | Coconino | AZ              | US     |

(23 out of 431 Selected)

Coconino\_Springs\_Nov\_13\_2016

- With the table open, we see that we have 23 springs selected.
- Spring features are connected to **tbl\_Surveys**, so the next step is to select all surveys that are connected to these selected springs. Click the Related Tables command  in the top left corner of the Table window, and choose the option that connects to **tbl\_Surveys**. Note that the list items include both the name of the relationship class that connects the tables, plus the name of the table. In this example, we want the first item, **Surveys\_by\_Site : tblSurveys**.

Table

Coconino\_Springs\_Nov\_13\_2016

Surveys\_by\_Site : tblSurveys  
PolygonSites\_by\_Site : tbl\_PolygonSite  
Solar\_by\_Site : tbl\_Solar

Displays the relationship classes that the current table participates in.

| OBJECTID * | SiteID * | SiteName             | County   | StateProvince * | Countr |
|------------|----------|----------------------|----------|-----------------|--------|
| 405        | 542      | Aspen Spring         | Coconino | AZ              | US     |
| 631        | 803      | Little Leroux Spring | Coconino | AZ              | US     |
| 632        | 804      | Orion Spring         | Coconino | AZ              | US     |
| 634        | 806      | Big Leroux Spring    | Coconino | AZ              | US     |
| 707        | 889      | Alto Spring          | Coconino | AZ              | US     |
| 715        | 897      | Beard Spring         | Coconino | AZ              | US     |
| 716        | 898      | Bear Jaw Spring      | Coconino | AZ              | US     |

(23 out of 431 Selected)

Coconino\_Springs\_Nov\_13\_2016

- As soon as we choose this option, the table window for **tbl\_Surveys** will open with the all the surveys associated with the selected springs automatically selected (59 of 654 surveys in this example):




Table

tbl\_Surveys

| OBJECTID * | SurveyID *  | SurveyDate * | SiteID * | Start_Time  | End_Time    |   |
|------------|-------------|--------------|----------|-------------|-------------|---|
| 29         | -2024975171 | 11/14/2013   | 18787    | 10:04:00 AM | 10:15:00 AM | Kelsey Johnson and Marguerite Hendrie           |
| 46         | -1959001419 | 6/10/2013    | 1003     | 4:00:00 PM  | 4:45:00 PM  | Kyle Paffett and Spencer Harris                 |
| 57         | -1920585708 | 8/20/2010    | 804      | 9:00:00 AM  | 12:30:00 PM | V. Markgraf, S. Ordway, and J. Norris           |
| 103        | -1742283341 | 6/6/2013     | 1069     | 3:00:00 PM  | 3:30:00 PM  | Kyle Paffett, Krista Sparks, and Spencer Harris |
| 156        | -1559757009 | 9/27/2013    | 898      | 5:30:00 PM  | 5:50:00 PM  | Larry Stevens                                   |
| 224        | -1355459782 | 9/24/2013    | 1144     | 4:45:00 PM  | 6:00:00 PM  | Larry Stevens and Jeri Ledbetter                |
| 231        | -1321522848 | 8/22/2010    | 436      | 9:50:00 AM  | 12:10:00 PM | J. Norris                                       |
| 244        | -1279539782 | 6/6/2013     | 965      | 2:15:00 PM  | 2:50:00 PM  | Kyle Paffett, Krista Sparks, and Spencer Harris |
| 310        | -1019850236 | 6/10/2013    | 889      | 1:30:00 PM  | 2:15:00 PM  | Kyle Paffett and Spencer Harris                 |
| 363        | -832867139  | 9/25/2013    | 1056     | 3:00:00 PM  | 3:45:00 PM  | Larry Stevens                                   |
| 404        | -675034504  | 6/6/2013     | 1002     | 3:45:00 PM  | 4:00:00 PM  | Kyle Paffett, Krista Sparks, and Spencer Harris |

(59 out of 654 Selected)

Coconino\_Springs\_Nov\_13\_2016

- 6) The next table in the chain is **tbl\_InvertSampling**, so click the Related Tables command  again and choose the option **InvertSampling\_by\_Survey : tbl\_InvertSampling**

Table

tbl\_Surveys


Polygons\_by\_Survey : tbl\_PolygonSurvey  
Vertebrates\_by\_Survey : tbl\_VertSurvey  
**InvertSampling\_by\_Survey : tbl\_InvertSampling**  
Flow\_by\_Survey : tbl\_flow  
WaterQuality\_by\_Survey : tbl\_WQData  
SEAP\_by\_Survey : tbl\_SEAP\_Scores  
Images\_by\_Survey : tbl\_images  
qtyVolume\_by\_Survey : tbl\_qtyvolume  
Reports\_by\_Survey : tbl\_reports  
Sada\_by\_Survey : tbl\_SadaProtocols  
HydroQual\_by\_Survey : tbl\_HydroQuality  
GDE\_Disturb\_by\_Survey : gde\_disturbance  
GDE\_MgmtInd\_by\_Survey : gde\_mgmtindicators  
Surveys\_by\_Site : WorldSprings

| Start_Time | End_Time    |   |
|------------|-------------|---|
| 0:04:00 AM | 10:15:00 AM | Kelsey Johnson and Marguerite Hendrie           |
| 0:00:00 PM | 4:45:00 PM  | Kyle Paffett and Spencer Harris                 |
| 0:00:00 AM | 12:30:00 PM | V. Markgraf, S. Ordway, and J. Norris           |
| 0:00:00 PM | 3:30:00 PM  | Kyle Paffett, Krista Sparks, and Spencer Harris |
| 3:30:00 PM | 5:50:00 PM  | Larry Stevens                                   |
| 4:45:00 PM | 6:00:00 PM  | Larry Stevens and Jeri Ledbetter                |
| 5:50:00 AM | 12:10:00 PM | J. Norris                                       |
| 1:15:00 PM | 2:50:00 PM  | Kyle Paffett, Krista Sparks, and Spencer Harris |
| 3:30:00 PM | 2:15:00 PM  | Kyle Paffett and Spencer Harris                 |
| 0:00:00 PM | 3:45:00 PM  | Larry Stevens                                   |
| 3:45:00 PM | 4:00:00 PM  | Kyle Paffett, Krista Sparks, and Spencer Harris |

- 7) This automatically opens the table **tbl\_InvertSampling**, with 351 of 3696 records selected:



| Object_ID * | InvertSample_ID * | SurveyID *  | FullName *                              | tic |
|-------------|-------------------|-------------|---|-----|
| 2505        | 2853              | -1920585708 | Hemiptera Gerridae                      | 1   |
| 2506        | 2854              | 1385011007  | Hymenoptera Vespidae Vespula            | 1   |
| 2507        | 2855              | 541438267   | Odonata                                 | 2   |
| 2508        | 2856              | -1321522848 | Diptera Culicidae                       |     |
| 14415       | 36233             | -509231821  | Hymenoptera Apidae Apis mellifera       | 1   |
| 14416       | 36234             | -509231821  | Coleoptera Erotylidae                   | 4   |
| 14932       | 36755             | -509231821  | Diptera Asilidae Proctacanthella micans |     |
| 15423       | 37246             | -832867139  | Hemiptera Gerridae                      | 1   |
| 15424       | 37247             | -832867139  | Hemiptera Gerridae                      | 1   |
| 15425       | 37248             | -832867139  | Hemiptera Gerridae                      | 1   |
| 18376       | 40238             | 2146237256  | Araneae Anyphaenidae Anyphaena pacifica |     |


- 8) The last table in the chain is **tlu\_TaxalInvert**, so click Related Tables command  again and choose the option **Taxonomy\_by\_Invertebrates : tlu\_TaxalInvert**.

| Object_ID * | InvertSample_ID * | SurveyID *  | FullName *                              | tic |
|-------------|-------------------|-------------|---|-----|
| 2505        | 2853              | -1920585708 | Hemiptera Gerridae                      | 1   |
| 2506        | 2854              | 1385011007  | Hymenoptera Vespidae Vespula            | 1   |
| 2507        | 2855              | 541438267   | Odonata                                 | 2   |
| 2508        | 2856              | -1321522848 | Diptera Culicidae                       |     |
| 14415       | 36233             | -509231821  | Hymenoptera Apidae Apis mellifera       | 1   |
| 14416       | 36234             | -509231821  | Coleoptera Erotylidae                   | 4   |
| 14932       | 36755             | -509231821  | Diptera Asilidae Proctacanthella micans |     |
| 15423       | 37246             | -832867139  | Hemiptera Gerridae                      | 1   |
| 15424       | 37247             | -832867139  | Hemiptera Gerridae                      | 1   |
| 15425       | 37248             | -832867139  | Hemiptera Gerridae                      | 1   |
| 18376       | 40238             | 2146237256  | Araneae Anyphaenidae Anyphaena pacifica |     |

- 9) And now we have our final table, with our final selection. This tells us that there are 149 invertebrate species observed in all surveys conducted on the original set of selected springs.



| Object_ID * | TID * | FullName *                                     | Kingdom  | Phylum     | Class     |
|-------------|-------|--|----------|------------|-----------|
| 56          | 57    | Araneae Anyphaenidae Anyphaena pacifica        | Animalia | Arthropoda | Arachnida |
| 102         | 104   | Araneae Linyphiidae Neriene radiata            | Animalia | Arthropoda | Arachnida |
| 143         | 147   | Coleoptera Carabidae Bembidion                 | Animalia | Arthropoda | Insecta   |
| 183         | 188   | Coleoptera Chrysomelidae Altica                | Animalia | Arthropoda | Insecta   |
| 224         | 230   | Coleoptera Coccinellidae Hippodamia convergens | Animalia | Arthropoda | Insecta   |
| 245         | 252   | Coleoptera Dytiscidae Agabus lugens            | Animalia | Arthropoda | Insecta   |
| 253         | 260   | Coleoptera Dytiscidae Rhantus gutticollis      | Animalia | Arthropoda | Insecta   |
| 329         | 340   | Araneae Lycosidae Pardosa                      | Animalia | Arthropoda | Arachnida |
| 453         | 466   | Araneae Theridiidae Steatoda                   | Animalia | Arthropoda | Arachnida |
| 478         | 492   | Chilopoda Lithobiidae                          | Animalia | Arthropoda | Chilopoda |
| 481         | 495   | Coleoptera                                     | Animalia | Arthropoda | Insecta   |

- 10) If you wish, you may export this selection set to a CSV or text file, or another table format, by clicking the “Table Options” command  (in the upper left corner of the Table window) and “Export” to open the “Export Data” window.

Export Data

Export: Selected records

Use the same coordinate system as:

☒ this layer's source data


☐ the data frame

☐ the feature dataset you export the data into  
(only applies if you export to a feature dataset in a geodatabase)

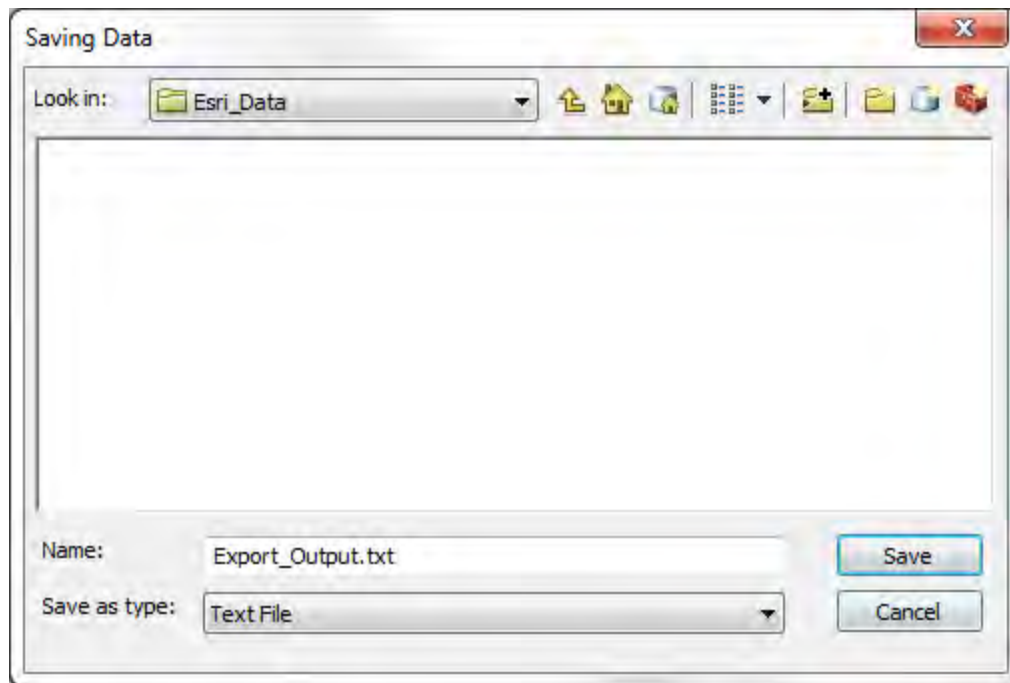
Output table:

S:\AIGIS\US\Esri\_Data\Esri\_Data.gdb\Export\_Output

OK Cancel

- 11) If you want to save as a text or CSV file, then click the “Browse” command  and change the “Save As Type” option to “Text File”:







### Identifying all springs where an invertebrate species was observed:

In the previous example, we found all species that were observed at a set of springs. A related task is to identify all springs at which a species (or multiple species) have been observed. We can take advantage of the same series of related tables as in the last example, but going in the opposite direction.

Recall that the Spring points are connected to **tbl\_Surveys**, which are then connected to **tbl\_InvertSampling**, and then to **tbl\_TaxaInvert**. ArcMap provides a simple way to select all species in **tbl\_TaxaInvert** based on an initial selection of springs (see Appendix B or the PDF file *Springs\_Database\_Relationship\_Classes\_Poster.pdf* for dataset connection diagrams).

**Springs Feature Class → tbl\_Surveys → tbl\_InvertSampling → tbl\_TaxaInvert**

Do the following:

- 1) Open **tbl\_TaxaInvert** and select the species you wish to analyze. This example will find all springs where the Western Tiger Swallowtail (*Lepidoptera Papilionidae Papilio rutulus*) have been observed.

Select by Attributes

Enter a WHERE clause to select records in the table window.

Method : Create a new selection

CommonName  
OBJECTID  
TID  
FullName  
Kingdom

= <> Like  
> >= And  
< <= Or  
\_ % ( ) Not  
Is In Null Get Unique Values Go To:

SELECT \* FROM tbl\_TaxaInvert WHERE:  
FullName = 'Lepidoptera Papilionidae Papilio rutulus'


Clear Verify Help Load... Save...  
Apply Close



| CommonName                | Object_ID * | TID * | FullName *  | Kingdom  | Phylum     |
|---------------------------|-------------|-------|---|----------|------------|
| <Null>                    | 2182        | 2345  | Lepidoptera Papilionidae Papilio machaon hollandi (form brucei) | Animalia | Arthropoda |
| <Null>                    | 2183        | 2346  | Lepidoptera Papilionidae Papilio machaon rudkini                | Animalia | Arthropoda |
| Two-tailed Swallowtail    | 2184        | 2347  | Lepidoptera Papilionidae Papilio multicaudata                   | Animalia | Arthropoda |
| <Null>                    | 2185        | 2349  | Lepidoptera Papilionidae Papilio polyxenes asteria              | Animalia | Arthropoda |
| Western Tiger Swallowtail | 2186        | 2350  | Lepidoptera Papilionidae Papilio rutulus                        | Animalia | Arthropoda |
| <Null>                    | 2187        | 2351  | Lepidoptera Papilionidae Papilio rutulus arizonensis            | Animalia | Arthropoda |
| <Null>                    | 2188        | 2352  | Lepidoptera Papilionidae Papilio rutulus glaucus                | Animalia | Arthropoda |
| <Null>                    | 2189        | 2353  | Lepidoptera Papilionidae Papilio rutulus rutulus                | Animalia | Arthropoda |

(1 out of 10263 Selected)

Figure 10: Selecting the species Western Tiger Swallowtail from tlu\_TaxaInvert

- 2) With the table open, we see that we have 1 species selected.
- 3) **tlu\_TaxaInvert** records are connected to **tbl\_InvertSampling**, so the next step is to select all Invertebrate Sampling records that are connected to the Western Tiger Swallowtail record.. Click the Related Tables command  in the top left corner of the Table window, and choose the option that connects to **tbl\_InvertSampling**. Note that the list items include both the name of the relationship class that connects the tables, plus the name of the table. In this example, we want the first item, **Taxonomy\_by\_Invertebrates : tbl\_InvertSampling**.

| CommonName                | Object_ID * | TID * | FullName *  | Kingdom  | Phylum     |
|---------------------------|-------------|-------|---|----------|------------|
| <Null>                    | 2182        | 2345  | Lepidoptera Papilionidae Papilio machaon hollandi (form brucei) | Animalia | Arthropoda |
| <Null>                    | 2183        | 2346  | Lepidoptera Papilionidae Papilio machaon rudkini                | Animalia | Arthropoda |
| Two-tailed Swallowtail    | 2184        | 2347  | Lepidoptera Papilionidae Papilio multicaudata                   | Animalia | Arthropoda |
| <Null>                    | 2185        | 2349  | Lepidoptera Papilionidae Papilio polyxenes asteria              | Animalia | Arthropoda |
| Western Tiger Swallowtail | 2186        | 2350  | Lepidoptera Papilionidae Papilio rutulus                        | Animalia | Arthropoda |
| <Null>                    | 2187        | 2351  | Lepidoptera Papilionidae Papilio rutulus arizonensis            | Animalia | Arthropoda |
| <Null>                    | 2188        | 2352  | Lepidoptera Papilionidae Papilio rutulus glaucus                | Animalia | Arthropoda |
| <Null>                    | 2189        | 2353  | Lepidoptera Papilionidae Papilio rutulus rutulus                | Animalia | Arthropoda |

(1 out of 10263 Selected)

- 4) As soon as we choose this option, the table **tbl\_InvertSampling** will open with the all the Invertebrate Sampling records associated with the Western Tiger Swallowtails automatically selected (27 of 2,717 records in this example):




Table

tbl\_InvertSampling

| Object_ID * | InvertSample_ID * | SurveyID *  | FullName *                               | tid * |
|-------------|-------------------|-------------|--|-------|
| 2547        | 2897              | 1376540382  | Lepidoptera Papilionidae Papilio rutulus | 2350  |
| 2550        | 2900              | -1862723362 | Lepidoptera Papilionidae Papilio rutulus | 2350  |
| 2583        | 2933              | -1534358509 | Lepidoptera Papilionidae Papilio rutulus | 2350  |
| 2584        | 2934              | 841003352   | Lepidoptera Papilionidae Papilio rutulus | 2350  |
| 4057        | 25477             | -1862723362 | Lepidoptera Papilionidae Papilio rutulus | 2350  |
| 4058        | 25478             | -1862723362 | Lepidoptera Papilionidae Papilio rutulus | 2350  |
| 4169        | 25589             | 562167948   | Lepidoptera Papilionidae Papilio rutulus | 2350  |
| 4176        | 25596             | 562167948   | Lepidoptera Papilionidae Papilio rutulus | 2350  |

(27 out of 2717 Selected)

tbl\_TaxaInvert | **tbl\_InvertSampling**

- 5) The next table in the chain is **tbl\_Surveys**, so click the Related Tables command  again and choose the option **InvertSampling\_by\_Survey : tbl\_Surveys**

Table

tbl\_InvertSampling

Taxonomy\_by\_Invertebrates : tlu\_TaxaInvert

**InvertSampling\_by\_Survey : tbl\_Surveys**

| Object_ID * | InvertSample_ID * | SurveyID *  | FullName *                               | tid * |
|-------------|-------------------|-------------|--|-------|
| 2547        | 2897              | 1376540382  | Lepidoptera Papilionidae Papilio rutulus | 2350  |
| 2550        | 2900              | -1862723362 | Lepidoptera Papilionidae Papilio rutulus | 2350  |
| 2583        | 2933              | -1534358509 | Lepidoptera Papilionidae Papilio rutulus | 2350  |
| 2584        | 2934              | 841003352   | Lepidoptera Papilionidae Papilio rutulus | 2350  |
| 4057        | 25477             | -1862723362 | Lepidoptera Papilionidae Papilio rutulus | 2350  |
| 4058        | 25478             | -1862723362 | Lepidoptera Papilionidae Papilio rutulus | 2350  |
| 4169        | 25589             | 562167948   | Lepidoptera Papilionidae Papilio rutulus | 2350  |
| 4176        | 25596             | 562167948   | Lepidoptera Papilionidae Papilio rutulus | 2350  |

(27 out of 2717 Selected)

tbl\_TaxaInvert | **tbl\_InvertSampling**

- 6) This automatically opens the table **tbl\_Surveys**, with 16 of 229 records selected:


Table

tbl\_Surveys

| OBJECTID * | SurveyID *  | SurveyDate * | SiteID * | Start_Time  | End_Time    |  |
|------------|-------------|--------------|----------|-------------|-------------|--|
| 71         | -1862723362 | 6/28/2010    | 524      | 8:10:00 AM  | 10:05:00 AM | L.E. Stevens, J.D. Ledbetter, G. Rink, W. S. Talashom  |
| 164        | -1534358509 | 6/26/2010    | 559      | 12:15:00 PM | 2:00:00 PM  | Larry Stevens, Jeri Ledbetter, Glenn Rink, William S.T |
| 1255       | 562167948   | 6/26/2010    | 525      | 9:50:00 AM  | 11:25:00 AM | Larry Stevens, Jeri Ledbetter, Glenn Rink, William S.T |
| 1327       | 841003352   | 6/26/2010    | 527      | 3:00:00 PM  | 4:25:00 PM  | Larry Stevens, Jeri Ledbetter, Glenn Rink, William S.T |
| 1665       | 1376540382  | 6/2/2010     | 556      | 12:45:00 PM | 1:40:00 PM  | Jeri Ledbetter, Larry Stevens, G. Rink, RJ Johnson, E  |
| 1986       | 2146221035  | 5/30/2014    | 555      | 9:25:00 AM  | 10:41:00 AM | Jenn Chavez, Jeris Ledbetter, Glenn Rink, Jeff Gless   |
| 10411      | 2146236870  | 7/11/2015    | 13761    | 1:30:00 PM  | 2:25:00 PM  | Larry Stevens, Molly Joyce, Jenn Chavez, Gloria Har    |
| 10412      | 2146236871  | 7/2/2015     | 170630   | 1:50:00 PM  | 3:20:00 PM  | Larry Stevens, Gloria Hartwick, Jenn Chavez, and C     |

(16 out of 229 Selected)

tbl\_TaxaInvert | tbl\_InvertSampling | **tbl\_Surveys**

- 7) The last table in the chain is the actual springs feature class **AS\_Springs\_March\_13\_2017\_Springs**. In this example, the Springs feature class is referred to as “WorldSprings” in the dropdown list, so click Related Tables command  again and choose the option **Surveys\_by\_Site : WorldSprings**.



Table

tbl\_Surv

- Polygons\_by\_Survey : tbl\_PolygonSurvey
- Vertebrates\_by\_Survey : tbl\_VertSurvey
- InvertSampling\_by\_Survey : tbl\_InvertSampling
- Flow\_by\_Survey : tbl\_flow
- WaterQuality\_by\_Survey : tbl\_WQData
- SEAP\_by\_Survey : tbl\_SEAP\_Scores
- Images\_by\_Survey : tbl\_images
- qtyVolume\_by\_Survey : tbl\_qtyvolume
- Reports\_by\_Survey : tbl\_reports
- Sada\_by\_Survey : tbl\_SadaProtocols
- HydroQual\_by\_Survey : tbl\_HydroQuality
- GDE\_Disturb\_by\_Survey : gde\_disturbance
- GDE\_MgmtInd\_by\_Survey : gde\_mgmtindicators
- Surveys\_by\_Site : WorldSprings

| Start_Time  | End_Time    |  |
|-------------|-------------|--|
| 10:00 AM    | 10:05:00 AM | L.E. Stevens, J.D. Ledbetter, G. Rink, W. S. Talashom  |
| 2:15:00 PM  | 2:00:00 PM  | Larry Stevens, Jeri Ledbetter, Glenn Rink, William S.T |
| 5:00:00 AM  | 11:25:00 AM | Larry Stevens, Jeri Ledbetter, Glenn Rink, William S.T |
| 00:00:00 PM | 4:25:00 PM  | Larry Stevens, Jeri Ledbetter, Glenn Rink, William S.T |
| 2:45:00 PM  | 1:40:00 PM  | Jeri Ledbetter, Larry Stevens, G. Rink, RJ Johnson, E  |
| 25:00 AM    | 10:41:00 AM | Jenn Chavez, Jeris Ledbetter, Glenn Rink, Jeff Gless   |
| 30:00 PM    | 2:25:00 PM  | Larry Stevens, Molly Joyce, Jenn Chavez, Gloria Har    |
| 50:00 PM    | 3:20:00 PM  | Larry Stevens, Gloria Hardwick, Jenn Chavez, and G     |

- 8) And now we are back to our Springs feature class, with all the springs selected that have recorded an observation of Western Tiger Swallowtail. This tells us that this species has been recorded at 16 of 1,289 springs.

Table

AS\_Springs\_March\_13\_2017\_Springs

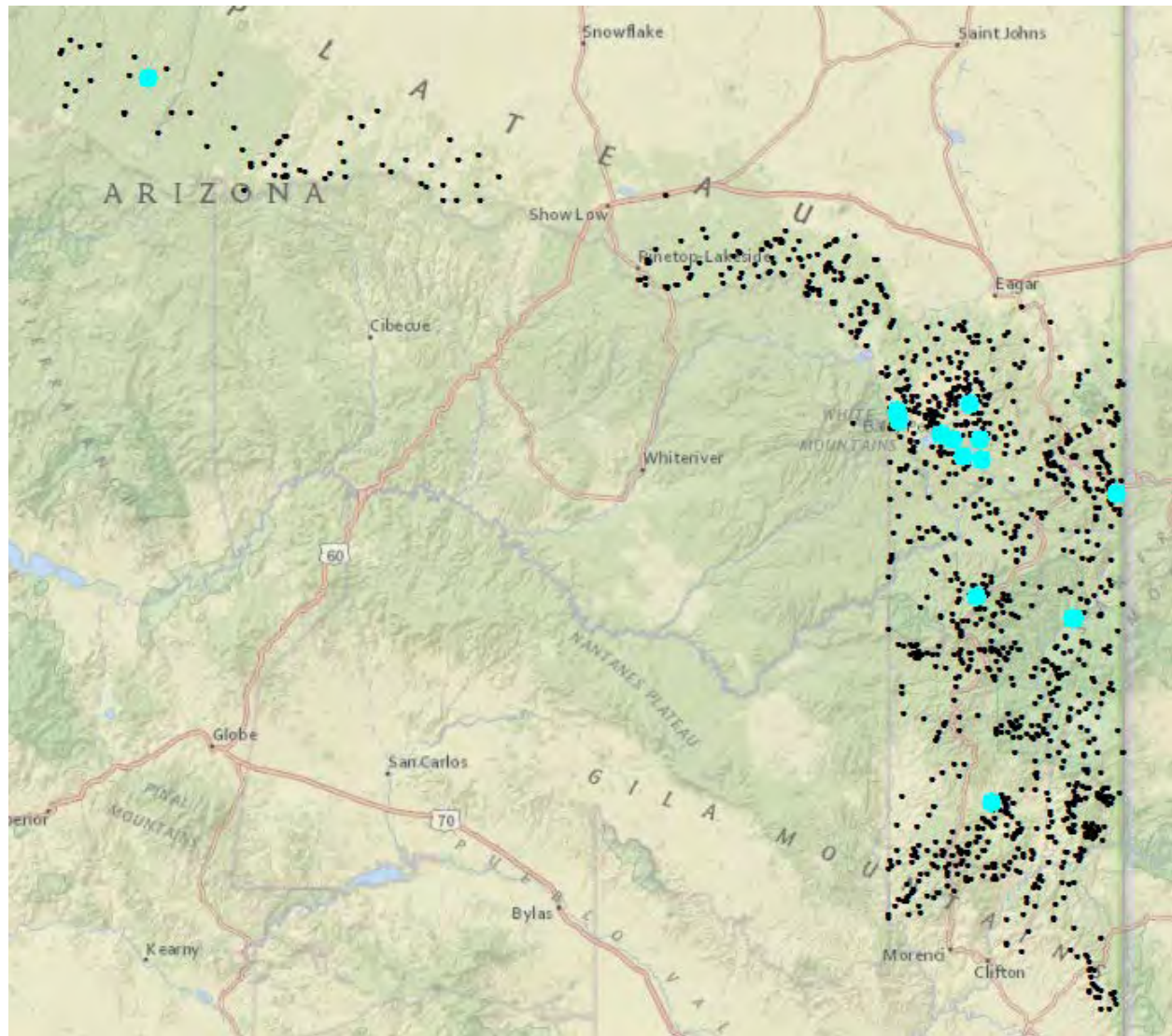
| OBJECTID * | SiteID * | SiteName                    | County * | StateProvince * | Country * | USGS_Quad         |
|------------|----------|-----------------------------|----------|-----------------|-----------|-------------------|
| 387        | 524      | Buckshot Spring             | Apache   | AZ              | US        | Big Lake North    |
| 388        | 525      | Burro Creek headwaters      | Apache   | AZ              | US        | Big Lake North    |
| 390        | 527      | Dump Spring                 | Apache   | AZ              | US        | Big Lake North    |
| 417        | 555      | Cedar Springs middle        | Greenlee | AZ              | US        | Bear Mountain     |
| 418        | 556      | Sledgehammer Spring         | Greenlee | AZ              | US        | Bear Mountain     |
| 421        | 559      | Stone Fir Spring            | Apache   | AZ              | US        | Big Lake North    |
| 4778       | 13453    | No Name Spring              | Greenlee | AZ              | US        | Pipestem Mountain |
| 5085       | 13761    | East Fork Spring Number Six | Apache   | AZ              | US        | Budd Knoll        |

(16 out of 1289 Selected)

tblu\_TaxaInvert tbl\_InvertSampling tbl\_Surveys AS\_Springs\_March\_13\_2017\_Springs

- 9) We may easily see where these springs are by viewing our Springs feature class in the map:







### Identifying All Springs with Flow Level $\geq$ Some Amount, when Field is Wrong Type

This example is similar to the one above, where we selected an Invertebrate Species and pushed the selection back to the Springs Feature Class. However, we have an extra challenge here because the attribute field we need to query on is a Text field, and we need to apply a Numeric query to it.

Suppose we want to identify all springs that have been observed to produce more than 0.5 liters per second of flow. This value is commonly measured during spring surveys, so we simply need to find the path of links that connect the Springs feature class to the Flow table.


Flow rates are recorded in **tbl\_flow**, which is linked to **tbl\_Surveys**, and then to **Springs Feature Class** (see Appendix B or the PDF file *Springs\_Database\_Relationship\_Classes\_Poster.pdf* for dataset connection diagrams).

#### **Springs Feature Class → tbl\_Surveys → tbl\_flow**

The special problem we face in this example is that the attribute field that contains the Flow (*MeasuredFlowLS*) is a *text* field rather than a *numeric* field. This means that a normal query will sort the values in alphabetical order rather than numeric, so that won't work.

Fortunately, we can write our query so that it converts the text values to numbers before performing the query. We use the SQL "CAST" function inside the query to convert.

Do the following:

- 1) Open **tbl\_flow** and then click the "Select by Attributes" command  to open the "Select by Attributes" window. Scroll down in the window to find the attribute field **MeasuredFlowLS**:



Last Revised:  
2/14/2018

Select by Attributes

Enter a WHERE clause to select records in the table window.

Method : Create a new selection

AverageOrCumulativeFlow  
 SitePercentCaptured  
**MeasuredFlowLS**  
 MeasurementLocation  
 SprBrookLengthM

= < > Like  
 > > = And  
 < < = Or  
 \_ % ( ) Not  
 Is In Null Get Unique Values Go To:

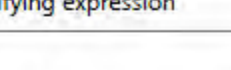
SELECT \* FROM tbl\_flow WHERE:

Clear Verify Help Load... Save...  
 Apply Close

2) Here's the tricky part. If **MeasuredFlowLS** was a numeric field, we could just create the query:

```
MeasuredFlowLS >= 0.5
```

and we would be good to go. Unfortunately, this query will crash the function because **MeasuredFlowLS** is a text field, and you'll see the following error message:



Verifying expression

There was an error with the expression.  
 An invalid SQL statement was used.  
 An invalid SQL statement was used. [tbl\_flow]

OK





- 3) Fortunately we can use the SQL CAST function to change the values of **MeasuredFlowLS** from text to numeric right inside the query. If you are curious, Google “SQL CAST” to see all the ways it can be used. In general, you structure it as:


**CAST(Field\_Name AS New\_Field\_Type)...**

- 4) In our case, the “New Field Type” is named “FLOAT” (for floating point number), so we modify our query as follows:

**CAST(MeasuredFlowLS AS FLOAT) >= 0.5**

- 5) Now the query works, and we get several Measured Flow records that have flow rates greater than 0.5 liters per second. With the table open, we see that we have 304 records selected.

| AverageOrCumulativeFlow | SitePercentCaptured | MeasuredFlowLS |   |
|-------------------------|---------------------|----------------|---|
| <Null>                  | <Null>              | <Null>         | <Null>  |
| <Null>                  | <Null>              | 19.20000       | 35 m downstream from source                     |
| <Null>                  | <Null>              | <Null>         | <Null>  |
| <Null>                  | <Null>              | 0.00000        | <Null>  |
| <Null>                  | <Null>              | 0.00000        | <Null>  |
| <Null>                  | 1.00                | 0.24000        | 61 m downstream from uppermost source in main c |
| <Null>                  | 1.00                | 0.00800        | <Null>  |
| <Null>                  | 1.00                | 0.05300        | Flow was measured 1.8 meters below the source.  |
| <Null>                  | 1.00                | 0.02100        | Flow was measured in the channel 4.8 meters dow |


- 6) The next table in the chain is **tbl\_Surveys**, so click the Related Tables command  and choose the option **Flow\_by\_Survey : tbl\_Surveys**

| AverageOrCumulativeFlow | SitePercentCaptured | MeasuredFlowLS |   |
|-------------------------|---------------------|----------------|---|
| <Nu                     | <Null>              | <Null>         | <Null>  |
| <Nu                     | <Null>              | 0.0000         | 35 m downstream from source                     |
| <Nu                     | <Null>              | <Null>         | <Null>  |
| <Nu                     | <Null>              | 0.0000         | <Null>  |
| <Null>                  | <Null>              | 0.00000        | <Null>  |
| <Null>                  | 1.00                | 0.24000        | 61 m downstream from uppermost source in main c |
| <Null>                  | 1.00                | 0.00800        | <Null>  |
| <Null>                  | 1.00                | 0.05300        | Flow was measured 1.8 meters below the source.  |
| <Null>                  | 1.00                | 0.02100        | Flow was measured in the channel 4.8 meters dow |

- 7) This automatically opens the table **tbl\_Surveys**, with 303 of 2,783 survey records selected:



| Object_ID * | SurveyID *  | SurveyDate * | SiteID * | Start_Time  | End_Time    |                                    |
|-------------|-------------|--------------|----------|-------------|-------------|------------------------------------|
| 34          | -1321019626 | 9/9/2010     | 625      | 10:30:00 AM | 12:50:00 PM | LES, AES, JDL, PW, LS, Workshop me |
| 63          | -480108042  | 6/27/2011    | 19654    | <Null>      | <Null>      | HK                                 |
| 74          | -265161535  | 6/21/2011    | 19693    | <Null>      | <Null>      | Heather & Boris                    |
| 101         | 759680515   | 7/11/2011    | 19651    | <Null>      | <Null>      | HK                                 |
| 122         | 1173187566  | 6/21/2011    | 19694    | <Null>      | <Null>      | Heather & Boris                    |
| 181         | 1380121663  | 7/6/2011     | 19655    | <Null>      | <Null>      | HK                                 |
| 190         | 1524706218  | 6/30/2011    | 19682    | <Null>      | <Null>      | Heidi Kloeppel                     |
| 194         | 1599039715  | 7/7/2011     | 19683    | <Null>      | <Null>      | HK                                 |
| 207         | 1874881277  | 8/3/2011     | 19665    | <Null>      | <Null>      | HK                                 |

- 8) The last table in the chain is the actual springs feature class **Nevada\_Springs\_Nov\_28\_2017**. In this example, the Springs feature class is referred to correctly as “Nevada\_Springs\_Nov\_28\_2017” in the dropdown list, so click Related Tables command  again and choose the option **Surveys\_by\_Site : Nevada\_Springs\_Nov\_28\_2017**.

| start_Time | End_Time    |                                    |
|------------|-------------|------------------------------------|
| 30:00 AM   | 12:50:00 PM | LES, AES, JDL, PW, LS, Workshop me |
| ull>       | <Null>      | HK                                 |
| ull>       | <Null>      | Heather & Boris                    |
| ull>       | <Null>      | HK                                 |
| ull>       | <Null>      | Heather & Boris                    |
| ull>       | <Null>      | HK                                 |
| ull>       | <Null>      | Heidi Kloeppel                     |
| ull>       | <Null>      | HK                                 |



- 9) And now we are back to our Springs feature class, with all the springs selected that have recorded at least one observation of our specified flow rate. This tells us that this flow rates of > 0.5 liters per second have been recorded at 253 of 24,171 springs.

| geometry * | object identifier * | SiteID * | SiteName                              | County * | StateProvince * |
|------------|---------------------|----------|---------------------------------------|----------|-----------------|
| Point      | 9430                | 107496   | Beetles Ranch Spring                  | Mineral  | NV              |
| Point      | 9552                | 107695   | Buck Brush                            | Lyon     | NV              |
| Point      | 24171               | 235879   | Moapa NWR, Pederson springs C         | Clark    | NV              |
| Point      | 101                 | 19665    | Intermittent Spring                   | Clark    | NV              |
| Point      | 2915                | 98987    | Lower Cane Spring                     | Humboldt | NV              |
| Point      | 3143                | 99233    | Upper Cane Spring                     | Humboldt | NV              |
| Point      | 3292                | 99391    | Unnamed Spring In Clear Creek Canyon  | Washoe   | NV              |
| Point      | 3360                | 99465    | Unnamed Spring 3.2 km west of Thunder | Washoe   | NV              |
| Point      | 3304                | 00400    | Near Bradens Springs                  | Washoe   | NV              |

(253 out of 24171 Selected)

tbl\_flow | tbl\_Surveys | Nevada\_Springs\_Nov\_28\_2017

- 10) We may easily see where these springs are by viewing our Springs feature class in the map:





A map of California showing the distribution of sampling locations. Red dots represent all sampling sites across the state, while cyan dots highlight specific sites used for the analysis. The map includes major geographical features such as the Sierra Nevada mountains, Central Valley, and Death Valley, as well as cities like Fresno, Visalia, Bakersfield, and Henderson.



Identifying all plant species recorded at a set of springs:

Identifying all plant species for a selected set of springs is very similar to identifying all vertebrate or invertebrate species, except the chain of connected tables is slightly longer. Specifically, the chain goes as follows (and see Appendix B or the PDF file *Springs\_Database\_Relationship\_Classes\_Poster.pdf* for details):

**Springs Feature Class → tbl\_Surveys → tbl\_PolygonSurvey → tbl\_PolygonFlora → tbl\_TaxaFlora**

- 1) As before, select the springs you want to analyze. In this example, we will use the same springs on or near the San Francisco Peaks near Flagstaff, Arizona that we used before:

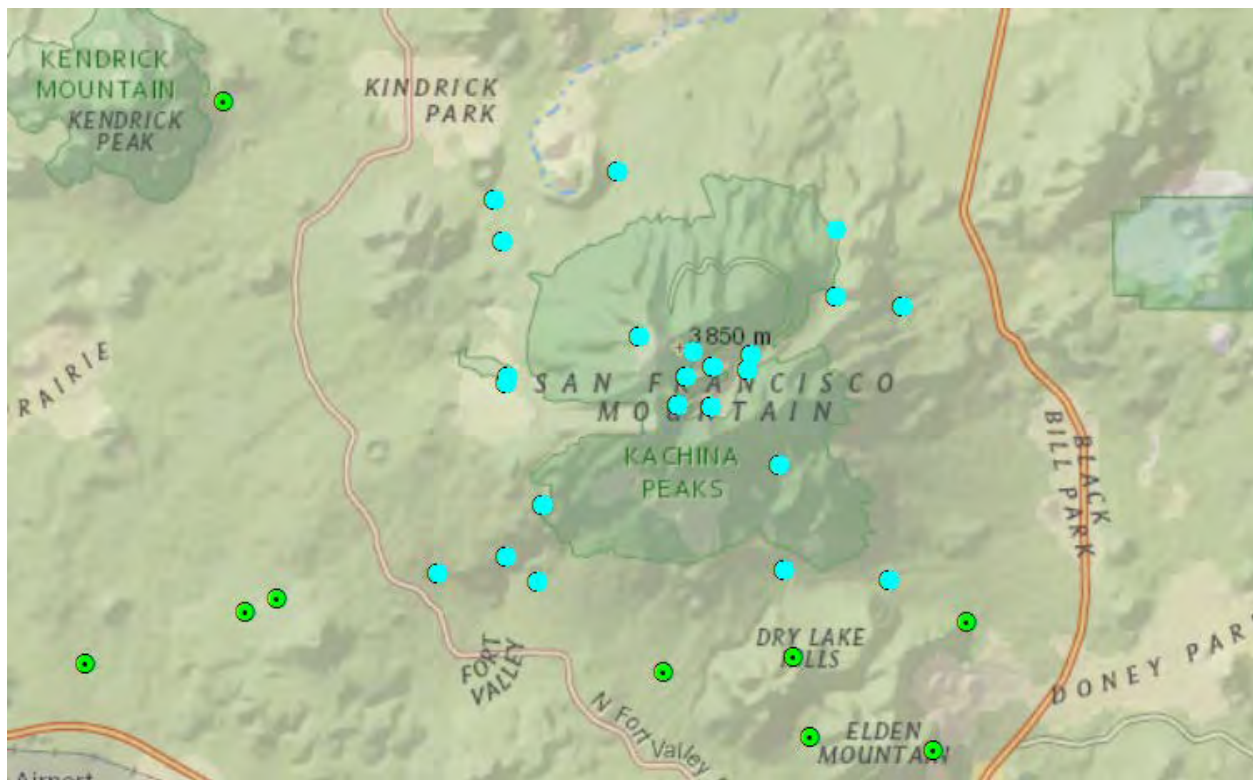


Figure 11: An initial selection of springs

- 2) Open the attribute table by right-clicking on the “Springs” layer in the table of contents and choosing “Open Attribute Table”. **Note:** You can also open attribute tables for selected layers and tables by hitting the [Control]-T keyboard shortcut.






Table

Coconino\_Springs\_Nov\_13\_2016

| OBJECTID * | SiteID * | SiteName                     | County   | StateProvince * | Countr |
|------------|----------|------------------------------|----------|-----------------|--------|
| 313        | 436      | Taylor Spring Humphreys Peak | Coconino | AZ              | US     |
| 322        | 446      | Viet Spring                  | Coconino | AZ              | US     |
| 405        | 542      | Aspen Spring                 | Coconino | AZ              | US     |
| 631        | 803      | Little Leroux Spring         | Coconino | AZ              | US     |
| 632        | 804      | Orion Spring                 | Coconino | AZ              | US     |
| 634        | 806      | Big Leroux Spring            | Coconino | AZ              | US     |
| 707        | 889      | Alto Spring                  | Coconino | AZ              | US     |
| 715        | 897      | Beard Spring                 | Coconino | AZ              | US     |
| 716        | 898      | Bear Jaw Spring              | Coconino | AZ              | US     |

(23 out of 431 Selected)

Coconino\_Springs\_Nov\_13\_2016

- 3) With the table open, we see that we have 23 springs selected.
- 4) Spring features are connected to **tbl\_Surveys**, so click the Related Tables command  in the top left of the Table window and choose the option that connects to **tbl\_Surveys** (specifically **Surveys\_by\_Site : tblSurveys**).

Table

Coconino\_Springs\_Nov\_13\_2016

Surveys\_by\_Site : tblSurveys

PolygonSites\_by\_Site : tbl\_PolygonSite

Solar\_by\_Site : tbl\_Solar

Displays the relationship classes that the current table participates in.

| OBJECTID * | SiteID * | SiteName             | County   | StateProvince * | Countr |
|------------|----------|----------------------|----------|-----------------|--------|
| 405        | 542      | Aspen Spring         | Coconino | AZ              | US     |
| 631        | 803      | Little Leroux Spring | Coconino | AZ              | US     |
| 632        | 804      | Orion Spring         | Coconino | AZ              | US     |
| 634        | 806      | Big Leroux Spring    | Coconino | AZ              | US     |
| 707        | 889      | Alto Spring          | Coconino | AZ              | US     |
| 715        | 897      | Beard Spring         | Coconino | AZ              | US     |
| 716        | 898      | Bear Jaw Spring      | Coconino | AZ              | US     |


(23 out of 431 Selected)

Coconino\_Springs\_Nov\_13\_2016

- 5) **tbl\_Surveys** opens with all the surveys associated with the selected springs automatically selected (59 of 654 surveys in this example):



| OBJECTID * | SurveyID *  | SurveyDate * | SiteID * | Start_Time  | End_Time    |   |
|------------|-------------|--------------|----------|-------------|-------------|---|
| 29         | -2024975171 | 11/14/2013   | 18787    | 10:04:00 AM | 10:15:00 AM | Kelsey Johnson and Marguerite Hendrie           |
| 46         | -1959001419 | 6/10/2013    | 1003     | 4:00:00 PM  | 4:45:00 PM  | Kyle Paffett and Spencer Harris                 |
| 57         | -1920585708 | 8/20/2010    | 804      | 9:00:00 AM  | 12:30:00 PM | V. Markgraf, S. Ordway, and J. Norris           |
| 103        | -1742283341 | 6/6/2013     | 1069     | 3:00:00 PM  | 3:30:00 PM  | Kyle Paffett, Krista Sparks, and Spencer Harris |
| 156        | -1559757009 | 9/27/2013    | 898      | 5:30:00 PM  | 5:50:00 PM  | Larry Stevens                                   |
| 224        | -1355459782 | 9/24/2013    | 1144     | 4:45:00 PM  | 6:00:00 PM  | Larry Stevens and Jeri Ledbetter                |
| 231        | -1321522848 | 8/22/2010    | 436      | 9:50:00 AM  | 12:10:00 PM | J. Norris                                       |
| 244        | -1279539782 | 6/6/2013     | 965      | 2:15:00 PM  | 2:50:00 PM  | Kyle Paffett, Krista Sparks, and Spencer Harris |
| 310        | -1019850236 | 6/10/2013    | 889      | 1:30:00 PM  | 2:15:00 PM  | Kyle Paffett and Spencer Harris                 |
| 363        | -832867139  | 9/25/2013    | 1056     | 3:00:00 PM  | 3:45:00 PM  | Larry Stevens                                   |
| 404        | -675034504  | 6/6/2013     | 1002     | 3:45:00 PM  | 4:00:00 PM  | Kyle Paffett, Krista Sparks, and Spencer Harris |

- 6) The next table in the chain is **tbl\_PolygonSurvey**, so use the Related Tables command  and choose the appropriate option (**Polygons\_by\_Survey : tbl\_PolygonSurvey**).

| Start_Time | End_Time    |                      |
|------------|-------------|----------------------|
| 0:04:00 AM | 10:15:00 AM | Kelsey Johnson an    |
| 00:00 PM   | 4:45:00 PM  | Kyle Paffett and Sp  |
| 00:00 AM   | 12:30:00 PM | V. Markgraf, S. Orr  |
| 00:00 PM   | 3:30:00 PM  | Kyle Paffett, Krista |
| 30:00 PM   | 5:50:00 PM  | Larry Stevens        |
| 45:00 PM   | 6:00:00 PM  | Larry Stevens and    |
| 50:00 AM   | 12:10:00 PM | J. Norris            |
| 15:00 PM   | 2:50:00 PM  | Kyle Paffett, Krista |
| 30:00 PM   | 2:15:00 PM  | Kyle Paffett and Sp  |
| 00:00 PM   | 3:45:00 PM  | Larry Stevens        |
| 45:00 PM   | 4:00:00 PM  | Kyle Paffett, Krista |

- 7) **tbl\_PolygonSurvey** opens automatically with 27 records selected:




Table

tbl\_PolygonSurvey

| Object_ID * | SurveyPolygonAutoID * | SitePolygonID * | SurveyID *  | SurfType * | SurfSut |
|-------------|-----------------------|-----------------|-------------|------------|---------|
| 671         | 782                   | 762             | 1003707383  | C          | <Null>  |
| 672         | 783                   | 763             | 1003707383  | CH         | riffle  |
| 673         | 784                   | 764             | 1003707383  | CH         | riffle  |
| 674         | 785                   | 765             | 1003707383  | TE         | LRZMRZ  |
| 675         | 786                   | 766             | 1003707383  | BW         | <Null>  |
| 1045        | 1177                  | 1155            | -1920585708 | CH         | <Null>  |
| 1046        | 1178                  | 1156            | -1920585708 | LGC        | <Null>  |
| 1047        | 1179                  | 1157            | 1385011007  | <Null>     | <Null>  |
| 1048        | 1180                  | 1158            | 541438267   | <Null>     | <Null>  |
| 1049        | 1181                  | 1159            | 541438267   | <Null>     | <Null>  |
| 1050        | 1182                  | 1160            | 541438267   | <Null>     | <Null>  |

1 (27 out of 446 Selected)

Coconino\_Springs\_Nov\_13\_2016 tbl\_Surveys tbl\_PolygonSurvey

- 8) The next table in the chain is **tbl\_PolygonFlora**, so use the Related Tables command  and choose the appropriate option (**Flora\_by\_Polygon : tbl\_PolygonFlora**).

Table

tbl\_Poly

Flora\_by\_Polygon : tbl\_PolygonFlora

PolygonSites\_by\_Survey : tbl\_PolygonSite\_Survey

Polygons\_by\_Survey : tbl\_Surveys

| Object_ID * | SurveyPolygonAutoID * | SitePolygonID * | SurveyID *  | SurfType * | SurfSut |
|-------------|-----------------------|-----------------|-------------|------------|---------|
| 671         | 782                   | 762             | 1003707383  | C          | <Null>  |
| 672         | 783                   | 763             | 1003707383  | CH         | riffle  |
| 673         | 784                   | 764             | 1003707383  | CH         | riffle  |
| 674         | 785                   | 765             | 1003707383  | TE         | LRZMRZ  |
| 675         | 786                   | 766             | 1003707383  | BW         | <Null>  |
| 1045        | 1177                  | 1155            | -1920585708 | CH         | <Null>  |
| 1046        | 1178                  | 1156            | -1920585708 | LGC        | <Null>  |
| 1047        | 1179                  | 1157            | 1385011007  | <Null>     | <Null>  |
| 1048        | 1180                  | 1158            | 541438267   | <Null>     | <Null>  |
| 1049        | 1181                  | 1159            | 541438267   | <Null>     | <Null>  |
| 1050        | 1182                  | 1160            | 541438267   | <Null>     | <Null>  |

1 (27 out of 446 Selected)

Coconino\_Springs\_Nov\_13\_2016 tbl\_Surveys tbl\_PolygonSurvey

- 9) **tbl\_PolygonFlora** opens with 239 records selected.






Table

tbl\_PolygonFlora

| Object_ID * | Flora_ID * | SurveyPolygonID * | FloraSpecies *        | tid * |
|-------------|------------|-------------------|-----------------------|-------|
| 5764        | 6852       | 782               | Mimulus guttatus      | 37526 |
| 5765        | 6853       | 783               | Mimulus guttatus      | 37526 |
| 5766        | 6854       | 784               | Mimulus guttatus      | 37526 |
| 5767        | 6855       | 782               | moss                  | 65573 |
| 5768        | 6856       | 783               | Poa pratensis         | 46291 |
| 5769        | 6857       | 784               | Poa pratensis         | 46291 |
| 5770        | 6858       | 785               | Poa pratensis         | 46291 |
| 5771        | 6859       | 783               | Geranium richardsonii | 26938 |
| 5772        | 6860       | 784               | Geranium richardsonii | 26938 |
| 5773        | 6861       | 785               | Geranium richardsonii | 26938 |
| 5774        | 6862       | 782               | Pteridium aquilinum   | 48646 |

1 (239 out of 38421 Selected)

Coconino\_Springs\_Nov\_13\_2016 tbl\_Surveys tbl\_PolygonSurvey tbl\_PolygonFlora

- 10) The final table in the chain is **tlu\_TaxaFlora**, so use the Related Tables command  and choose the appropriate option (**Flora\_by\_Polygon : tbl\_PolygonFlora**).

Table

tbl\_Poly

Taxonomy\_by\_Flora : tlu\_TaxaFlora


CoverCode\_by\_Polygon : tlu\_covercodes

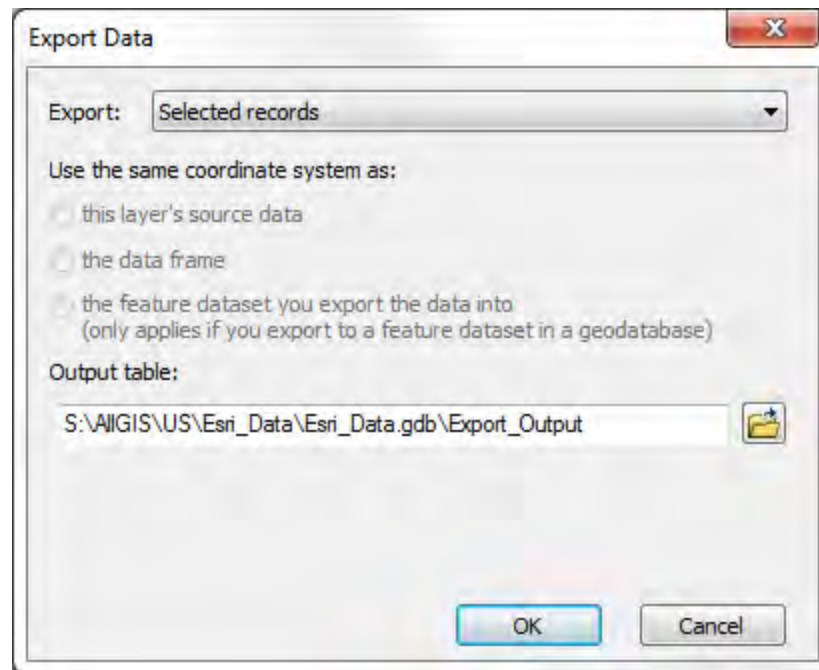
Flora\_by\_Polygon : tbl\_PolygonSurvey


| Object_ID * | Flora_ID * | SurveyPolygonID * | FloraSpecies *        | tid * |
|-------------|------------|-------------------|-----------------------|-------|
| 5766        | 6854       | 784               | Mimulus guttatus      | 37526 |
| 5767        | 6855       | 782               | moss                  | 65573 |
| 5768        | 6856       | 783               | Poa pratensis         | 46291 |
| 5769        | 6857       | 784               | Poa pratensis         | 46291 |
| 5770        | 6858       | 785               | Poa pratensis         | 46291 |
| 5771        | 6859       | 783               | Geranium richardsonii | 26938 |
| 5772        | 6860       | 784               | Geranium richardsonii | 26938 |
| 5773        | 6861       | 785               | Geranium richardsonii | 26938 |
| 5774        | 6862       | 782               | Pteridium aquilinum   | 48646 |

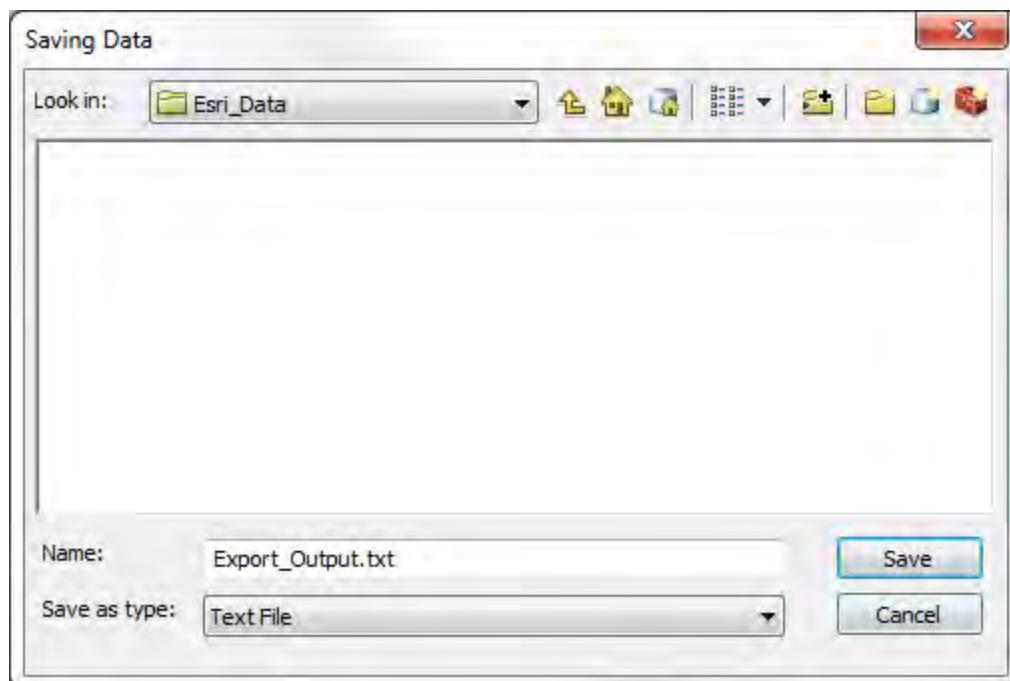
1 (239 out of 38421 Selected)

Coconino\_Springs\_Nov\_13\_2016 tbl\_Surveys tbl\_PolygonSurvey tbl\_PolygonFlora

- 11) And now we have the 128 Flora species that were observed in all surveys done on the 23 originally selected springs.
- 12) If you wish, you may export this selection set to a CSV or text file, or another table format, by clicking the "Table Options" command  (in the upper left corner of the Table window) and "Export" to open the "Export Data" window.



- 13) If you want to save as a text or CSV file, then click the “Browse” command  and change the “Save As Type” option to “Text File”:





## Appendix A: Dataset Summaries

### File Geodatabase:

**Summary:** This geodatabase was exported from Springs Online (<http://springsdata.org/>) on " & Format(Now, "h:Nn:Ss \h\r\s, dddd, mmmm d, yyyy") & ". For more information regarding data compilation methods and a description of the database see <http://springstewardshipinstitute.org/database-manual-1/>. The data are a snapshot only; more current data are available at Springs Online; contact the Springs Stewardship Institute for a more recent export.

### Feature Class:

**Summary:** This feature class contains a subset of springs extracted from the Springs Stewardship Institute Springs Online database (<http://springdata.org/>), exported at " & Format(Now, "h:Nn:Ss \h\r\s, dddd, mmmm d, yyyy") & " from Springs Online. Each record in the feature class has a unique SiteID assigned by the online database. This feature class is related to the primary table, tbl\_Surveys, in a one to many relationship.

### Tables:

#### 1] tbl\_Surveys

**Summary:** This table contains general information about surveys compiled from Springs Online. The sites feature class has a one to many relationship with this table using a unique SiteID assigned by Springs Online. Each survey is assigned a unique SurveyID.

#### 2] tbl\_PolygonSurvey

**Summary:** When surveying a spring, surveyors generally divide the local area surrounding the spring in to one or more distinct regions based on habitat factors. This table describes those polygons.

#### 3] tbl\_VertSurvey

**Summary:** This table describes vertebrate species observed during a survey.

#### 4] tbl\_InvertSampling

**Summary:** This table describes invertebrate species observed during a survey.

#### 5] tbl\_flow

**Summary:** This table summarizes flow measurements taken during a survey.

#### 6] tbl\_WQData

**Summary:** This table describes water quality measurements (e.g. pH, Dissolved Oxygen, Specific Conductance, etc.) taken during a survey.

#### 7] tbl\_SEAP\_Scores

**Summary:** This table describes Springs Ecosystem Assessment Protocol (SEAP) data observed during a survey. This table has been modified from the original table in the Springs Online dataset, in order to replace SEAP and SEAP Risk code values with textual descriptions.



8] [tbl\\_PolygonFlora](#)

**Summary:** This table describes plant species observed in each polygon during a survey.

9] [tlu\\_TaxaVert](#)

**Summary:** This table gives additional details on vertebrate species.

10] [tlu\\_TaxaInvert](#)

**Summary:** This table gives additional details on invertebrate species.

11] [tlu\\_flowrate](#)

**Summary:** This table gives textual definitions for flow rate codes found in Surveys table.

12] [tlu\\_flowpersistence](#)

**Summary:** This table gives textual definitions for flow persistence codes found in Surveys table.

13] [tlu\\_flowconsistency](#)

**Summary:** This table gives textual definitions for flow consistency codes found in Surveys table.

14] [tlu\\_flowvariability](#)

**Summary:** This table gives textual definitions for flow variability codes found in Surveys table.

15] [tlu\\_TaxaFlora](#)

**Summary:** This table gives additional details on plant species.

16] [tlu\\_covercodes](#)

**Summary:** This table gives textual definitions for Cover Code values found in various tables.

17] [tlu\\_endemism\\_Vert](#)

**Summary:** This table gives textual definitions for Endemism code values found in various tables.

18] [tlu\\_springlefecycle\\_Vert](#)

**Summary:** This table gives textual definitions for Spring Life History code values found in various tables.

19] [tlu\\_aquaticstatus\\_Vert](#)

**Summary:** This table gives textual definitions for Aquatic Status code values found in various tables.

20] [tlu\\_esastatus\\_Vert](#)

**Summary:** This table gives textual definitions for ESA Status (U.S. Endangered Species Act) code values found in various tables.

21] [tlu\\_iucnstatus\\_Vert](#)

**Summary:** This table gives textual definitions for IUCN (International Union for the Conservation of Nature) code values found in various tables.

22] [tlu\\_nativestatuscodes\\_Invert](#)

**Summary:** This table gives textual definitions for Native Status code values found in various tables.



23] [tlu\\_protectedarea\\_Invert](#)

**Summary:** This table gives textual definitions for Protected Area code values found in various tables.

24] [tlu\\_endemism\\_Invert](#)

**Summary:** This table gives textual definitions for Endemism code values found in various tables.

25] [tlu\\_springlifehistory\\_Invert](#)

**Summary:** This table gives textual definitions for Spring Life History code values found in various tables.

26] [tlu\\_aquaticstatus\\_Invert](#)

**Summary:** This table gives textual definitions for Aquatic Status code values found in various tables.

27] [tlu\\_esastatus\\_Invert](#)

**Summary:** This table gives textual definitions for ESA Status (U.S. Endangered Species Act) code values found in various tables.

28] [tlu\\_iucnstatus\\_Invert](#)

**Summary:** This table gives textual definitions for IUCN (International Union for the Conservation of Nature) code values found in various tables.

29] [tlu\\_nativestatuscodes](#)

**Summary:** This table gives textual definitions for Native Status code values found in various tables.

30] [tlu\\_protectedarea](#)

**Summary:** This table gives textual definitions for Protected Area code values found in various tables.

31] [tlu\\_wetlandstatus\\_les](#)

**Summary:** This table gives textual definitions for Wetland Status code values found in various tables.

32] [tlu\\_endemism](#)

**Summary:** This table gives textual definitions for Endemism code values found in various tables.

33] [tlu\\_springmicrohabitatuse](#)

**Summary:** This table gives textual definitions for Spring Microhabitat Use code values found in various tables.

34] [tlu\\_springlifehistory](#)

**Summary:** This table gives textual definitions for Spring Life History code values found in various tables.

35] [tlu\\_aquaticstatus](#)

**Summary:** This table gives textual definitions for Aquatic Status code values found in various tables.

36] [tlu\\_esastatus](#)

**Summary:** This table gives textual definitions for ESA Status (U.S. Endangered Species Act) code values found in various tables.



37] [tlu\\_iucnstatus](#)

**Summary:** This table gives textual definitions for IUCN (International Union for the Conservation of Nature) code values found in various tables.

38] [tlu\\_covercodes\\_TaxaFlora](#)

**Summary:** This table gives textual definitions for Cover Code values found in various tables.

39] [tbl\\_images](#)

**Summary:** This table contains hyperlinks to images taken at springs and sketchmaps drawn at springs. These images are stored on the Springs Stewardship Institute website.

40] [tbl\\_qtyvolume](#)

**Summary:** This table contains details on water quantity and volume measurements taken during surveys, including fill times, flow rates, volumen measurements and estimates of percent captured.

41] [tbl\\_reports](#)

**Summary:** This table contains hyperlinks to previously-generated reports that describe this survey. These reports are stored on the Springs Stewardship Institute website. In the original Springs Online database, this table is combined with 'tbl\_site\_reports', which contains reports describing both surveys and sites.

42] [tbl\\_PolygonSite](#)

**Summary:** This table names and describes polygonal subregions within a spring site area.

43] [tbl\\_Solar](#)

**Summary:** This table gives several solar insolation-related variables describing the site, including Latitude, sunrise and sunset by month, and seasonal and annual solar energy (in Mj and percent).

44] [tbl\\_SadaProtocols](#)

**Summary:** This table lists survey data measured at a spring using survey protocols developed by Don Sada and Karl Pohlmann (see [https://www.dri.edu/images/stories/conferences\\_and\\_workshops/spring-fed-wetlands/spring-fed-wetlands-sada-pohlmann-protocol.pdf](https://www.dri.edu/images/stories/conferences_and_workshops/spring-fed-wetlands/spring-fed-wetlands-sada-pohlmann-protocol.pdf))

45] [tbl\\_HydroQuality](#)

**Summary:** This table contains collection and water quality comments gathered in H2O Quality analysis of survey.

46] [tbl\\_PolygonSite\\_Survey](#)

**Summary:** This table names and describes polygonal subregions within a spring site area.

47] [gde\\_disturbance](#)

**Summary:** This table lists various types of disturbance events that may have been observed during a survey.

48] [gde\\_mgmtindicators](#)

**Summary:** This table describes whether management-related conditions were observed during a survey.



49] [gde\\_domveglevel1](#)

**Summary:** Dominant lifeform and vegetation data for Level 1 surveys only

50] [gde\\_otherveg](#)

**Summary:** List of plant species not included in quadrat survey or line intercept.

51] [gde\\_soil](#)

**Summary:** These soil sampling methods are generalized from USDA NRCS (2006) and Schoeneberger et al. (2002) and are intended to give a general characterization of the soils and focus mainly on the level and duration of saturation. Information on the soil profile gives an indication of the amount of peat development and peat texture, the degree of water table fluctuation, and some indication of the underlying aquifer materials. This field guide is not intended for soil mapping purposes or to generate rigorous characterizations of soil profiles for the entire wetland site. Methods here should not be used when regulatory or jurisdictional requirements must be met.

52] [gde\\_surveys](#)

**Summary:** Primary summary of measurements taken during GDE survey.

53] [gde\\_watertable](#)

**Summary:** Survey water table data.

54] [gdelu\\_areamethod](#)

**Summary:** Lookup table for method used to determine site area.

55] [gdelu\\_bryoabundance](#)

**Summary:** Lookup table for bryophyte abundance observed during survey.

56] [gdelu\\_cutlevel](#)

**Summary:** Lookup table for plant cover density cutoff level at which a species is not recorded.

57] [gdelu\\_flowpatternin](#)

**Summary:** Lookup table for source of water flowing into area.

58] [gdelu\\_flowpatternout](#)

**Summary:** Lookup table for possible ways water leaves the area.

59] [gdelu\\_lifeformrank](#)

**Summary:** Lookup table for Life Form Ranks.

60] [gdelu\\_purpose](#)

**Summary:** Lookup table for primary reason that survey was conducted.

61] [gdelu\\_soillocation](#)

**Summary:** Lookup table for method of selecting soil sample locations.

62] [gdelu\\_soilmethod](#)

**Summary:** Lookup table for method of taking soil sample.





63] [gdelu\\_veg\\_surr](#)

**Summary:** Lookup table for dominant surrounding vegetation.

64] [gdelu\\_watertabletype](#)

**Summary:** Lookup table for water table types.

65] [gdelu\\_wtlocation](#)

**Summary:** Lookup table for method used to choose water table sample locations.

66] [gdelu\\_wtsource](#)

**Summary:** Lookup table for water source used to sample water table.

67] [tbl\\_seapcultscores](#)

**Summary:** This table describes Springs Ecosystem Assessment Protocol (SEAP) cultural data observed during a survey.

68] [tbl\\_seapsummary](#)

**Summary:** This table summarizes Springs Ecosystem Assessment Protocol (SEAP) data observed during a survey.

69] [tbl\\_site\\_treatment](#)

**Summary:** Table indicating whether this site lay within a designated treatment area. This table contains codes for the treatment areas, and the associated table 'tlu\_treatmentareas' gives details on each treatment.

70] [tbl\\_wqlocation](#)

**Summary:** Table indicating where water quality was sampled, and relationship with spring source.

71] [tlu\\_wqparameters](#)

**Summary:** Lookup table of water quality tests, including various measures of water quality (pH, temperature, conductance, concentrations of various chemicals), the units these are measured in, and the protocols that describe these measures.

72] [tlu\\_lithoprimary](#)

**Summary:** Lookup table of primary lithology options at spring.

73] [tlu\\_lithosecondary](#)

**Summary:** Lookup table of finer-detail lithology at spring. This table subsets the categories listed in 'tlu\_lithoprimary' into multiple sub-categories.

74] [tlu\\_emergenceenvironment](#)

**Summary:** Lookup table of various spring emergence environments, such as above-ground, into a lake, stream, pond, estuary or marine environment, or beneath a glacier.

75] [tlu\\_proclaimednf](#)

**Summary:** If the spring is located within a US Forest Service National Forest, then this is the proclaimed name of that national forest.



[76\] tlu\\_huc12](#)

**Summary:** Lookup table of 12-digit HUCs (Hydrologic Unit Codes).

[77\] tlu\\_sfcwateroccur](#)

**Summary:** Lookup table of level of surface water ranked from dry to extensive standing and flowing water.

[78\] tlu\\_seapcodes](#)

**Summary:** This table defines the field names in the table 'tbl\_seapscore'. Because the structure of 'tbl\_seapscore' is somewhat obscure and difficult, we have prepared an alternative version of this table that is much easier to interpret. Please see 'tbl\_SEAP\_Scores' for an easier-to-read version of 'tbl\_seapscore'.

[79\] tlu\\_seapcondoptions](#)

**Summary:** This table defines the SEAP score values in the table 'tbl\_seapscore'. Because the structure of 'tbl\_seapscore' is somewhat obscure and difficult, we have prepared an alternative version of this table that is much easier to interpret. Please see 'tbl\_SEAP\_Scores' for an easier-to-read version of 'tbl\_seapscore'.

[80\] tlu\\_sensitive](#)

**Summary:** Lookup table for sensitivity codes, indicating whether the spring locations and/or survey information should be treated as sensitive and not shared publicly.

[81\] tlu\\_sada\\_disturbance](#)

**Summary:** Lookup table of disturbance levels according to Sada protocol.

[82\] tlu\\_globalconservationstatus](#)

**Summary:** This table lists NatureServe Status, Codes and Descriptions of the global conservation status of a species.

[83\] tlu\\_ntnlconservationstatus](#)

**Summary:** This table lists NatureServe Status, Codes and Descriptions of the national conservation status of a species.

[84\] tlu\\_globalconservationstatus\\_Vert](#)

**Summary:** This table lists NatureServe Status, Codes and Descriptions of the global conservation status of a species. This 'Vert' version of the table is identical to 'tlu\_globalconservationstatus', and included to provide a link directly to the table 'tlu\_TaxaVert'.

[85\] tlu\\_globalconservationstatus\\_Invert](#)

**Summary:** This table lists NatureServe Status, Codes and Descriptions of the global conservation status of a species. This 'Invert' version of the table is identical to 'tlu\_globalconservationstatus', and included to provide a link directly to the table 'tlu\_TaxaInvert'.



#### 86] [tlu\\_ntnlconservationstatus\\_Vert](#)

**Summary:** This table lists NatureServe Status, Codes and Descriptions of the national conservation status of a species. This 'Vert' version of the table is identical to 'tlu\_ntnlconservationstatus', and included to provide a link directly to the table 'tlu\_TaxaVert'.

#### 87] [tlu\\_ntnlconservationstatus\\_Invert](#)

**Summary:** This table lists NatureServe Status, Codes and Descriptions of the national conservation status of a species. This 'Invert' version of the table is identical to 'tlu\_ntnlconservationstatus', and included to provide a link directly to the table 'tlu\_TaxaInvert'.

#### 88] [tlu\\_weather](#)

**Summary:** Lookup table of possible precipitation conditions at time of survey.

#### 89] [tlu\\_wqlocation](#)

**Summary:** Lookup table of possible locations at which water quality is sampled.

#### 90] [tlu\\_seapriskoptions](#)

**Summary:** This table defines the SEAP risk score values in the table 'tbl\_seapscore'. Because the structure of 'tbl\_seapscore' is somewhat obscure and difficult, we have prepared an alternative version of this table that is much easier to interpret. Please see 'tbl\_SEAP\_Scores' for an easier-to-read version of 'tbl\_seapscore'.

#### 91] [tlu\\_huc](#)

**Summary:** Lookup table of 8-digit HUCs (Hydrologic Unit Codes).

#### 92] [tbl\\_wqdata\\_Location](#)

**Summary:** This table describes water quality measurements (e.g. pH, Dissolved Oxygen, Specific Conductance, etc.) taken during a survey. This table is identical to 'tbl\_wqdata' except that it is positioned to provide a 1-to-Many relationship with 'tbl\_wqlocation'.

#### 93] [tlu\\_wqparameters\\_location](#)

**Summary:** Lookup table of water quality tests, including various measures of water quality (pH, temperature, conductance, concentrations of various chemicals), the units these are measured in, and the protocols that describe these measures. This table is identical to 'tlu\_wqparameters' except that it is positioned to provide a 1-to-Many relationship with 'tbl\_wqlocation' (through 'tbl\_wqdata\_location').

#### 94] [tlu\\_treatmentareas](#)

**Summary:** Lookup table of treatment area details. This table contains details for treatment codes listed in 'tbl\_site\_treatment'.

#### 95] [tbl\\_seapscore](#)

**Summary:** This table contains the source SEAP (Springs Ecosystem Assessment Protocol) condition and risk scores in SpringsOnline. Because the structure of 'tbl\_seapscore' is somewhat obscure and difficult, we have prepared an alternative version of this table that is much easier to interpret. Please see 'tbl\_SEAP\_Scores' for an easier-to-read version of 'tbl\_seapscore'.



96] [tlu\\_surveyprotocol](#)

**Summary:** Lookup table providing details on several optional survey protocols.

97] [tlu\\_TaxaFlora\\_GDE](#)

**Summary:** This table gives additional details on plant species. It is a subset of the table 'tlu\_TaxaFlora' that is linked directly to the GDE tables, and only contains those Flora species that were observed in a GDE survey.

98] [tlu\\_globalconservationstatus\\_GDE](#)

**Summary:** This table lists NatureServe Status, Codes and Descriptions of the global conservation status of a species. This 'GDE' version of the table is identical to 'tlu\_globalconservationstatus', and included to provide a link directly to GDE tables.

99] [tlu\\_nativestatuscodes\\_GDE](#)

**Summary:** This table gives textual definitions for Native Status code values found in various tables.

100] [tlu\\_protectedarea\\_GDE](#)

**Summary:** This table gives textual definitions for Protected Area code values found in various tables.

101] [tlu\\_wetlandstatus\\_les\\_GDE](#)

**Summary:** This table gives textual definitions for Wetland Status code values found in various tables.

102] [tlu\\_endemism\\_GDE](#)

**Summary:** This table gives textual definitions for Endemism code values found in various tables.

103] [tlu\\_springmicrohabitatuse\\_GDE](#)

**Summary:** This table gives textual definitions for Spring Microhabitat Use code values found in various tables.

104] [tlu\\_springlefecyclehistory\\_GDE](#)

**Summary:** This table gives textual definitions for Spring Life History code values found in various tables.

105] [tlu\\_aquaticstatus\\_GDE](#)

**Summary:** This table gives textual definitions for Aquatic Status code values found in various tables.

106] [tlu\\_esastatus\\_GDE](#)

**Summary:** This table gives textual definitions for ESA Status (U.S. Endangered Species Act) code values found in various tables.

107] [tlu\\_covercodes\\_TaxaFlora\\_GDE](#)

**Summary:** This table gives textual definitions for Cover Code values found in various tables.

108] [tlu\\_iucnstatus\\_GDE](#)

**Summary:** This table gives textual definitions for IUCN (International Union for the Conservation of Nature) code values found in various tables.



## Springs Point Relationship Classes:

### 1] Surveys\_by\_Site

**Summary:** This relationship class creates a One to Many relationship from the Spring Locations point feature class (Origin Key Attribute Field = [SiteID]) to 'tbl\_Surveys' (Foreign Key Attribute Field = [SiteID]).

### 2] Polygons\_by\_Survey

**Summary:** This relationship class creates a One to Many relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'tbl\_PolygonSurvey' (Foreign Key Attribute Field = [SurveyID]).

### 3] Vertebrates\_by\_Survey

**Summary:** This relationship class creates a One to Many relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'tbl\_VertSurvey' (Foreign Key Attribute Field = [SurveyID]).

### 4] InvertSampling\_by\_Survey

**Summary:** This relationship class creates a One to Many relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'tbl\_InvertSampling' (Foreign Key Attribute Field = [SurveyID]).

### 5] Flow\_by\_Survey

**Summary:** This relationship class creates a One to One relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'tbl\_flow' (Foreign Key Attribute Field = [SurveyID]).

### 6] WaterQuality\_by\_Survey

**Summary:** This relationship class creates a One to Many relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'tbl\_WQData' (Foreign Key Attribute Field = [SurveyID]).

### 7] SEAP\_by\_Survey

**Summary:** This relationship class creates a One to One relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'tbl\_SEAP\_Scores' (Foreign Key Attribute Field = [SurveyID]).

### 8] Flora\_by\_Polygon

**Summary:** This relationship class creates a One to Many relationship from 'tbl\_PolygonSurvey' (Origin Key Attribute Field = [SurveyPolygonAutoID]) to 'tbl\_PolygonFlora' (Foreign Key Attribute Field = [SurveyPolygonID]).

### 9] Taxonomy\_by\_Vertebrates

**Summary:** This relationship class creates a One to One relationship from 'tbl\_VertSurvey' (Origin Key Attribute Field = [tid]) to 'tlu\_TaxaVert' (Foreign Key Attribute Field = [TID]).

### 10] Taxonomy\_by\_Invertebrates

**Summary:** This relationship class creates a One to One relationship from 'tbl\_InvertSampling' (Origin Key Attribute Field = [tid]) to 'tlu\_TaxaInvert' (Foreign Key Attribute Field = [TID]).

### 11] Flow\_Rate\_by\_Flow

**Summary:** This relationship class creates a One to One relationship from 'tbl\_flow' (Origin Key Attribute Field = [FlowRateMean]) to 'tlu\_flowrate' (Foreign Key Attribute Field = [CastFlowRate]).



#### 12] Flow\_Persistence\_by\_Flow

**Summary:** This relationship class creates a One to One relationship from 'tbl\_flow' (Origin Key Attribute Field = [Persistence]) to 'tlu\_flowpersistence' (Foreign Key Attribute Field = [Persistence]).

#### 13] Flow\_Consistency\_by\_Flow

**Summary:** This relationship class creates a One to One relationship from 'tbl\_flow' (Origin Key Attribute Field = [FlowConsistency]) to 'tlu\_flowconsistency' (Foreign Key Attribute Field = [FlowConsistency]).

#### 14] Flow\_Variability\_by\_Flow

**Summary:** This relationship class creates a One to One relationship from 'tbl\_flow' (Origin Key Attribute Field = [FlowVariability]) to 'tlu\_flowvariability' (Foreign Key Attribute Field = [FlowVariability]).

#### 15] Taxonomy\_by\_Flora

**Summary:** This relationship class creates a One to One relationship from 'tbl\_PolygonFlora' (Origin Key Attribute Field = [tid]) to 'tlu\_TaxaFlora' (Foreign Key Attribute Field = [TID]).

#### 16] CoverCode\_by\_Polygon

**Summary:** This relationship class creates a One to One relationship from 'tbl\_PolygonFlora' (Origin Key Attribute Field = [FloraCoverCode]) to 'tlu\_covercodes' (Foreign Key Attribute Field = [CoverCode]).

#### 17] Endemism\_by\_Vert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaVert' (Origin Key Attribute Field = [EndemismLevel]) to 'tlu\_endemism\_Vert' (Foreign Key Attribute Field = [EndemismLevel]).

#### 18] SpLifeHist\_by\_Vert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaVert' (Origin Key Attribute Field = [SpringLifeHistory]) to 'tlu\_springlifehistory\_Vert' (Foreign Key Attribute Field = [CastSpringLifeHistory]).

#### 19] AquaticStatus\_by\_Vert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaVert' (Origin Key Attribute Field = [AquaticStatus]) to 'tlu\_aquaticstatus\_Vert' (Foreign Key Attribute Field = [AquaticStatus]).

#### 20] ESA\_by\_Vert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaVert' (Origin Key Attribute Field = [ESAstatus]) to 'tlu\_esastatus\_Vert' (Foreign Key Attribute Field = [ESAstatus]).

#### 21] IUCN\_by\_Vert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaVert' (Origin Key Attribute Field = [IUCNstatus]) to 'tlu\_iucnstatus\_Vert' (Foreign Key Attribute Field = [IUCNstatus]).



## 22] NativeStatus\_by\_Invert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaInvert' (Origin Key Attribute Field = [DefaultNativeStatus]) to 'tlu\_nativestatuscodes\_Invert' (Foreign Key Attribute Field = [NativeStatusCode]).

## 23] Protected\_Area\_by\_Invert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaInvert' (Origin Key Attribute Field = [DefaultProtectedArea]) to 'tlu\_protectedarea\_Invert' (Foreign Key Attribute Field = [ProtectedArea]).

## 24] Endemism\_by\_Invert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaInvert' (Origin Key Attribute Field = [EndemismLevel]) to 'tlu\_endemism\_Invert' (Foreign Key Attribute Field = [EndemismLevel]).

## 25] SpLifeHist\_by\_Invert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaInvert' (Origin Key Attribute Field = [SpringLifeHistory]) to 'tlu\_springlifehistory\_Invert' (Foreign Key Attribute Field = [CastSpringLifeHistory]).

## 26] Aquatic\_Status\_by\_Invert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaInvert' (Origin Key Attribute Field = [AquaticStatus]) to 'tlu\_aquaticstatus\_Invert' (Foreign Key Attribute Field = [AquaticStatus]).

## 27] ESA\_by\_Invert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaInvert' (Origin Key Attribute Field = [ESASTatus]) to 'tlu\_esastatus\_Invert' (Foreign Key Attribute Field = [ESASTatus]).

## 28] IUCN\_by\_Invert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaInvert' (Origin Key Attribute Field = [IUCNstatus]) to 'tlu\_iucnstatus\_Invert' (Foreign Key Attribute Field = [IUCNstatus]).

## 29] NativeStat\_by\_Flora

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora' (Origin Key Attribute Field = [DefaultNativeStatus]) to 'tlu\_nativestatuscodes' (Foreign Key Attribute Field = [NativeStatusCode]).

## 30] Protected\_by\_Flora

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora' (Origin Key Attribute Field = [DefaultProtectedArea]) to 'tlu\_protectedarea' (Foreign Key Attribute Field = [ProtectedArea]).

## 31] Wetland\_by\_Flora

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora' (Origin Key Attribute Field = [DefaultWetlandStatus]) to 'tlu\_wetlandstatus\_les' (Foreign Key Attribute Field = [WetlandCode]).





### 32] Endemism\_by\_Flora

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora' (Origin Key Attribute Field = [EndemismLevel]) to 'tlu\_endemism' (Foreign Key Attribute Field = [EndemismLevel]).

### 33] SpringHab\_by\_Flora

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora' (Origin Key Attribute Field = [SpringHabitatUse]) to 'tlu\_springmicrohabitatuse' (Foreign Key Attribute Field = [SpringUse]).

### 34] SpLifeHist\_by\_Flora

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora' (Origin Key Attribute Field = [SpringLifeHistory]) to 'tlu\_springlifehistory' (Foreign Key Attribute Field = [CastSpringLifeHistory]).

### 35] Aquatic\_by\_Flora

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora' (Origin Key Attribute Field = [AquaticStatus]) to 'tlu\_aquaticstatus' (Foreign Key Attribute Field = [AquaticStatus]).

### 36] ESA\_by\_Flora

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora' (Origin Key Attribute Field = [ESAstatus]) to 'tlu\_esastatus' (Foreign Key Attribute Field = [ESAstatus]).

### 37] IUCN\_by\_Flora

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora' (Origin Key Attribute Field = [IUCNstatus]) to 'tlu\_iucnstatus' (Foreign Key Attribute Field = [IUCNstatus]).

### 38] CoverCodes\_by\_Flora

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora' (Origin Key Attribute Field = [DefaultCoverCode]) to 'tlu\_covercodes\_TaxaFlora' (Foreign Key Attribute Field = [CoverCode]).

### 39] Images\_by\_Survey

**Summary:** This relationship class creates a One to Many relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'tbl\_images' (Foreign Key Attribute Field = [SurveyID]).

### 40] qtyVolume\_by\_Survey

**Summary:** This relationship class creates a One to Many relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'tbl\_qtyvolume' (Foreign Key Attribute Field = [SurveyID]).

### 41] Reports\_by\_Survey

**Summary:** This relationship class creates a One to Many relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'tbl\_reports' (Foreign Key Attribute Field = [SurveyID]).

### 42] PolygonSites\_by\_Site

**Summary:** This relationship class creates a One to Many relationship from the Spring Locations point feature class (Origin Key Attribute Field = [SiteID]) to 'tbl\_PolygonSite' (Foreign Key Attribute Field = [SiteID]).



#### 43] Solar\_by\_Site

**Summary:** This relationship class creates a One to One relationship from the Spring Locations point feature class (Origin Key Attribute Field = [SiteID]) to 'tbl\_Solar' (Foreign Key Attribute Field = [SiteID]).

#### 44] PolygonSites\_by\_Survey

**Summary:** This relationship class creates a One to One relationship from 'tbl\_PolygonSurvey' (Origin Key Attribute Field = [SitePolygonID]) to 'tbl\_PolygonSite\_Survey' (Foreign Key Attribute Field = [PolygonID]).

#### 45] Sada\_by\_Survey

**Summary:** This relationship class creates a One to One relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'tbl\_SadaProtocols' (Foreign Key Attribute Field = [SurveyID]).

#### 46] HydroQual\_by\_Survey

**Summary:** This relationship class creates a One to One relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'tbl\_HydroQuality' (Foreign Key Attribute Field = [SurveyID]).

#### 47] GDE\_gdesurvey\_by\_survey

**Summary:** This relationship class creates a One to One relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'gde\_surveys' (Foreign Key Attribute Field = [SurveyID]).

#### 48] GDE\_Purpose\_by\_GDE\_Survey

**Summary:** This relationship class creates a One to One relationship from 'gde\_surveys' (Origin Key Attribute Field = [Purpose]) to 'gdelu\_purpose' (Foreign Key Attribute Field = [Purpose]).

#### 49] GDE\_WaterTableType\_by\_GDE\_Survey

**Summary:** This relationship class creates a One to One relationship from 'gde\_surveys' (Origin Key Attribute Field = [WaterTableType]) to 'gdelu\_watertabletype' (Foreign Key Attribute Field = [WaterTableType]).

#### 50] GDE\_FlowPatternIn\_by\_GDE\_Surveys

**Summary:** This relationship class creates a One to One relationship from 'gde\_surveys' (Origin Key Attribute Field = [FlowPatternIn]) to 'gdelu\_flowpatternin' (Foreign Key Attribute Field = [FlowPatternIn]).

#### 51] GDE\_FlowPatternOut\_by\_GDE\_Surveys

**Summary:** This relationship class creates a One to One relationship from 'gde\_surveys' (Origin Key Attribute Field = [FlowPatternOut]) to 'gdelu\_flowpatternout' (Foreign Key Attribute Field = [FlowPatternOut]).

#### 52] GDE\_OtherVeg\_by\_GDE\_Surveys

**Summary:** This relationship class creates a One to Many relationship from 'gde\_surveys' (Origin Key Attribute Field = [SurveyID]) to 'gde\_otherveg' (Foreign Key Attribute Field = [SurveyID]).

#### 53] GDE\_Soil\_by\_GDE\_Surveys

**Summary:** This relationship class creates a One to Many relationship from 'gde\_surveys' (Origin Key Attribute Field = [SurveyID]) to 'gde\_soil' (Foreign Key Attribute Field = [SurveyID]).



#### 54] GDE\_SoilLocation\_by\_GDE\_Soil

**Summary:** This relationship class creates a One to One relationship from 'gde\_soil' (Origin Key Attribute Field = [SoilLocation]) to 'gdelu\_soillocation' (Foreign Key Attribute Field = [SoilLocation]).

#### 55] GDE\_SoilMethod\_by\_GDE\_Soil

**Summary:** This relationship class creates a One to One relationship from 'gde\_soil' (Origin Key Attribute Field = [Method]) to 'gdelu\_soilmethod' (Foreign Key Attribute Field = [Method]).

#### 56] GDE\_WaterTable\_by\_GDE\_Surveys

**Summary:** This relationship class creates a One to Many relationship from 'gde\_surveys' (Origin Key Attribute Field = [SurveyID]) to 'gde\_watertable' (Foreign Key Attribute Field = [SurveyID]).

#### 57] GDE\_WTSource\_by\_GDE\_WaterTable

**Summary:** This relationship class creates a One to One relationship from 'gde\_watertable' (Origin Key Attribute Field = [Source]) to 'gdelu\_wtsource' (Foreign Key Attribute Field = [WTSource]).

#### 58] GDE\_WTLocation\_by\_GDE\_WaterTable

**Summary:** This relationship class creates a One to One relationship from 'gde\_watertable' (Origin Key Attribute Field = [MsmtLocation]) to 'gdelu\_wtlocation' (Foreign Key Attribute Field = [WTLocation]).

#### 59] GDE\_DomVegLevel\_by\_GDE\_Survey

**Summary:** This relationship class creates a One to One relationship from 'gde\_surveys' (Origin Key Attribute Field = [SurveyID]) to 'gde\_domveglevel1' (Foreign Key Attribute Field = [SurveyID]).

#### 60] GDE\_Disturbance\_by\_GDE\_Survey

**Summary:** This relationship class creates a One to One relationship from 'gde\_surveys' (Origin Key Attribute Field = [SurveyID]) to 'gde\_disturbance' (Foreign Key Attribute Field = [SurveyID]).

#### 61] GDE\_MgmtInd\_by\_GDE\_Surveys

**Summary:** This relationship class creates a One to One relationship from 'gde\_surveys' (Origin Key Attribute Field = [SurveyID]) to 'gde\_mgmtindicators' (Foreign Key Attribute Field = [SurveyID]).

#### 62] GDE\_VegSurr\_by\_GDE\_DomVegLevel

**Summary:** This relationship class creates a One to One relationship from 'gde\_domveglevel1' (Origin Key Attribute Field = [Veg\_Surr]) to 'gdelu\_veg\_surr' (Foreign Key Attribute Field = [Veg\_Surr]).

#### 63] GDE\_BryoAbundance\_by\_GDE\_DomVegLevel

**Summary:** This relationship class creates a One to One relationship from 'gde\_domveglevel1' (Origin Key Attribute Field = [BryoAbundance]) to 'gdelu\_bryoabundance' (Foreign Key Attribute Field = [BryoAbundance]).

#### 64] GDE\_CutLevel\_by\_GDE\_DomVegLevel

**Summary:** This relationship class creates a One to One relationship from 'gde\_domveglevel1' (Origin Key Attribute Field = [CutLevelCode]) to 'gdelu\_cutlevel' (Foreign Key Attribute Field = [CutLevelCode]).

#### 65] GDE\_TreeRank\_by\_GDE\_DomVeglevel

**Summary:** This relationship class creates a One to One relationship from 'gde\_domveglevel1' (Origin Key Attribute Field = [TreeRank]) to 'gdelu\_lifeformrank' (Foreign Key Attribute Field = [Rank]).



#### 66] GDE\_ShrubRank\_by\_GDE\_DomVegLevel

**Summary:** This relationship class creates a One to One relationship from 'gde\_domveglevel1' (Origin Key Attribute Field = [ShrubRank]) to 'gdelu\_lifeformrank' (Foreign Key Attribute Field = [Rank]).

#### 67] GDE\_GraminoidRank\_by\_GDE\_DomVegLevel

**Summary:** This relationship class creates a One to One relationship from 'gde\_domveglevel1' (Origin Key Attribute Field = [GraminoidRank]) to 'gdelu\_lifeformrank' (Foreign Key Attribute Field = [Rank]).

#### 68] GDE\_ForRank\_by\_GDE\_DomVegLevel

**Summary:** This relationship class creates a One to One relationship from 'gde\_domveglevel1' (Origin Key Attribute Field = [ForRank]) to 'gdelu\_lifeformrank' (Foreign Key Attribute Field = [Rank]).

#### 69] GDE\_AquaticRank\_by\_GDE\_DomVegLevel

**Summary:** This relationship class creates a One to One relationship from 'gde\_domveglevel1' (Origin Key Attribute Field = [AquaticRank]) to 'gdelu\_lifeformrank' (Foreign Key Attribute Field = [RankDescription]).

#### 70] GDE\_UnknownRank\_by\_GDE\_DomVegLevel

**Summary:** This relationship class creates a One to One relationship from 'gde\_domveglevel1' (Origin Key Attribute Field = [UnknownRank]) to 'gdelu\_lifeformrank' (Foreign Key Attribute Field = [Rank]).

#### 71] GDE\_BryophyteRank\_by\_GDE\_DomVegLevel

**Summary:** This relationship class creates a One to One relationship from 'gde\_domveglevel1' (Origin Key Attribute Field = [BryophyteRank]) to 'gdelu\_lifeformrank' (Foreign Key Attribute Field = [Rank]).

#### 72] GDE\_AreaMethod\_by\_Survey

**Summary:** This relationship class creates a One to One relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [Area\_Method]) to 'gdelu\_areamethod' (Foreign Key Attribute Field = [Area\_Method]).

#### 73] NtnlConsStatus\_by\_Flora

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora' (Origin Key Attribute Field = [NtnlConservationStatus]) to 'tlu\_ntnlconservationstatus' (Foreign Key Attribute Field = [CastNtnlConservationStatus]).

#### 74] GlobalConsStatus\_by\_Flora

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora' (Origin Key Attribute Field = [GlobalConservationStatus]) to 'tlu\_globalconservationstatus' (Foreign Key Attribute Field = [CastGlobalConservationStatus]).

#### 75] NtnlConsStatus\_by\_Vert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaVert' (Origin Key Attribute Field = [NtnlConservationStatus]) to 'tlu\_ntnlconservationstatus\_Vert' (Foreign Key Attribute Field = [CastNtnlConservationStatus]).



#### 76] GlobalConsStats\_by\_Vert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaVert' (Origin Key Attribute Field = [GlobalConservationStatus]) to 'tlu\_globalconservationstatus\_Vert' (Foreign Key Attribute Field = [CastGlobalConservationStatus]).

#### 77] NtnlConsStatus\_by\_Invert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaInvert' (Origin Key Attribute Field = [NtnlConservationStatus]) to 'tlu\_ntnlconservationstatus\_Invert' (Foreign Key Attribute Field = [CastNtnlConservationStatus]).

#### 78] GlobalConsStatus\_by\_Invert

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaInvert' (Origin Key Attribute Field = [GlobalConservationStatus]) to 'tlu\_globalconservationstatus\_Invert' (Foreign Key Attribute Field = [CastGlobalConservationStatus]).

#### 79] SEAP\_CultureScores\_by\_Survey

**Summary:** This relationship class creates a One to One relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'tbl\_seapcultscores' (Foreign Key Attribute Field = [SurveyID]).

#### 80] SEAP\_Summaries\_by\_Survey

**Summary:** This relationship class creates a One to One relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'tbl\_seapsummary' (Foreign Key Attribute Field = [SurveyID]).

#### 81] Weather\_by\_Survey

**Summary:** This relationship class creates a One to One relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [Weather]) to 'tlu\_weather' (Foreign Key Attribute Field = [Weather]).

#### 82] SFCWaterOccurance\_by\_Survey

**Summary:** This relationship class creates a One to One relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SfcWaterOccur]) to 'tlu\_sfcwateroccur' (Foreign Key Attribute Field = [SfcWaterOccur]).

#### 83] LithoPrimary\_by\_Site

**Summary:** This relationship class creates a One to One relationship from the Spring Locations point feature class (Origin Key Attribute Field = [LithoPrimary]) to 'tlu\_lithoprimary' (Foreign Key Attribute Field = [LithoPrimary]).

#### 84] LithoSecondary\_by\_Site

**Summary:** This relationship class creates a One to One relationship from the Spring Locations point feature class (Origin Key Attribute Field = [LithoSecondary]) to 'tlu\_lithosecondary' (Foreign Key Attribute Field = [LithoSecondary]).

#### 85] EmergenceEnvironment\_by\_Site

**Summary:** This relationship class creates a One to One relationship from the Spring Locations point feature class (Origin Key Attribute Field = [EmergenceEnvironment]) to 'tlu\_emergenceenvironment' (Foreign Key Attribute Field = [EmergenceEnvironment]).



#### 86] ProclaimedNatForest\_by\_Site

**Summary:** This relationship class creates a One to One relationship from the Spring Locations point feature class (Origin Key Attribute Field = [ProclaimedNF]) to 'tlu\_proclaimednf' (Foreign Key Attribute Field = [ProclaimedNF]).

#### 87] HUC8\_by\_Site

**Summary:** This relationship class creates a One to One relationship from the Spring Locations point feature class (Origin Key Attribute Field = [HUC]) to 'tlu\_huc' (Foreign Key Attribute Field = [HUC\_ID]).

#### 88] HUC12\_by\_Site

**Summary:** This relationship class creates a One to One relationship from the Spring Locations point feature class (Origin Key Attribute Field = [CastHUC\_12]) to 'tlu\_huc12' (Foreign Key Attribute Field = [HUC12]).

#### 89] SiteTreatment\_by\_Site

**Summary:** This relationship class creates a One to Many relationship from the Spring Locations point feature class (Origin Key Attribute Field = [SiteID]) to 'tbl\_site\_treatment' (Foreign Key Attribute Field = [SiteID]).

#### 90] Sensitivity\_by\_Site

**Summary:** This relationship class creates a One to One relationship from the Spring Locations point feature class (Origin Key Attribute Field = [Sensitivity]) to 'tlu\_sensitive' (Foreign Key Attribute Field = [Sensitive]).

#### 91] WQLocation\_by\_Survey

**Summary:** This relationship class creates a One to Many relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'tbl\_wqlocation' (Foreign Key Attribute Field = [SurveyID]).

#### 92] WQData\_Location\_by\_WQLocation

**Summary:** This relationship class creates a One to Many relationship from 'tbl\_wqlocation' (Origin Key Attribute Field = [WQLocation\_ID]) to 'tbl\_WQData\_location' (Foreign Key Attribute Field = [WQLocation\_ID]).

#### 93] WQLocationLU\_by\_WQLocation

**Summary:** This relationship class creates a One to One relationship from 'tbl\_wqlocation' (Origin Key Attribute Field = [LocationWQ]) to 'tlu\_wqlocation' (Foreign Key Attribute Field = [Location]).

#### 94] WQParameters\_by\_WQData

**Summary:** This relationship class creates a One to One relationship from 'tbl\_WQData' (Origin Key Attribute Field = [WQParameter\_ID]) to 'tlu\_wqparameters' (Foreign Key Attribute Field = [WQParameter\_ID]).

#### 95] WQParams\_by\_WQData\_Location

**Summary:** This relationship class creates a One to One relationship from 'tbl\_wqdata\_Location' (Origin Key Attribute Field = [WQParameter\_ID]) to 'tlu\_wqparameters\_location' (Foreign Key Attribute Field = [WQParameter\_ID]).





#### 96] TreatmentArea\_by\_SiteTreatment

**Summary:** This relationship class creates a One to One relationship from 'tbl\_site\_treatment' (Origin Key Attribute Field = [TreatmentAreaID]) to 'tlu\_treatmentareas' (Foreign Key Attribute Field = [TreatmentAreaID]).

#### 97] SEAP\_Original\_by\_Survey

**Summary:** This relationship class creates a One to One relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyID]) to 'tbl\_seapscore' (Foreign Key Attribute Field = [SurveyID]).

#### 98] Protocol\_by\_Survey

**Summary:** This relationship class creates a One to One relationship from 'tbl\_Surveys' (Origin Key Attribute Field = [SurveyProtocol]) to 'tlu\_surveyprotocol' (Foreign Key Attribute Field = [CastProtocolID]).

#### 99] TaxaFlora\_by\_GDE\_DomVegLevel1\_Tree

**Summary:** This relationship class creates a One to One relationship from 'gde\_domveglevel1' (Origin Key Attribute Field = [TreeSpeciesTID]) to 'tlu\_TaxaFlora\_GDE' (Foreign Key Attribute Field = [TID]).

#### 100] TaxaFlora\_by\_GDE\_DomVegLevel1\_Aquatic

**Summary:** This relationship class creates a One to One relationship from 'gde\_domveglevel1' (Origin Key Attribute Field = [AquaticSpeciesTID]) to 'tlu\_TaxaFlora\_GDE' (Foreign Key Attribute Field = [TID]).

#### 101] TaxaFlora\_by\_GDE\_DomVegLevel1\_Shruh

**Summary:** This relationship class creates a One to One relationship from 'gde\_domveglevel1' (Origin Key Attribute Field = [ShruhSpeciesTID]) to 'tlu\_TaxaFlora\_GDE' (Foreign Key Attribute Field = [TID]).

#### 102] TaxaFlora\_by\_GDE\_DomVegLevel1\_Gram

**Summary:** This relationship class creates a One to One relationship from 'gde\_domveglevel1' (Origin Key Attribute Field = [GraminoidSpeciesTID]) to 'tlu\_TaxaFlora\_GDE' (Foreign Key Attribute Field = [TID]).

#### 103] TaxaFlora\_by\_GDE\_DomVegLevel1\_Forh

**Summary:** This relationship class creates a One to One relationship from 'gde\_domveglevel1' (Origin Key Attribute Field = [ForhSpeciesTID]) to 'tlu\_TaxaFlora\_GDE' (Foreign Key Attribute Field = [TID]).

#### 104] GlobalConsStatus\_by\_Flora\_GDE

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora\_GDE' (Origin Key Attribute Field = [GlobalConservationStatus]) to 'tlu\_globalconservationstatus\_GDE' (Foreign Key Attribute Field = [CastGlobalConservationStatus]).

#### 105] NativeStat\_by\_Flora\_GDE

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora\_GDE' (Origin Key Attribute Field = [DefaultNativeStatus]) to 'tlu\_nativestatuscodes\_GDE' (Foreign Key Attribute Field = [NativeStatusCode]).



#### 106] Protected\_by\_Flora\_GDE

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora\_GDE' (Origin Key Attribute Field = [DefaultProtectedArea]) to 'tlu\_protectedarea\_GDE' (Foreign Key Attribute Field = [ProtectedArea]).

#### 107] Wetland\_by\_Flora\_GDE

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora\_GDE' (Origin Key Attribute Field = [DefaultWetlandStatus]) to 'tlu\_wetlandstatus\_les\_GDE' (Foreign Key Attribute Field = [WetlandCode]).

#### 108] Endemism\_by\_Flora\_GDE

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora\_GDE' (Origin Key Attribute Field = [EndemismLevel]) to 'tlu\_endemism\_GDE' (Foreign Key Attribute Field = [EndemismLevel]).

#### 109] SpringHab\_by\_Flora\_GDE

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora\_GDE' (Origin Key Attribute Field = [SpringHabitatUse]) to 'tlu\_springmicrohabitatuse\_GDE' (Foreign Key Attribute Field = [SpringUse]).

#### 110] SpLifeHist\_by\_Flora\_GDE

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora\_GDE' (Origin Key Attribute Field = [SpringLifeHistory]) to 'tlu\_springlifehistory\_GDE' (Foreign Key Attribute Field = [CastSpringLifeHistory]).

#### 111] Aquatic\_by\_Flora\_GDE

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora\_GDE' (Origin Key Attribute Field = [AquaticStatus]) to 'tlu\_aquaticstatus\_GDE' (Foreign Key Attribute Field = [AquaticStatus]).

#### 112] ESA\_by\_Flora\_GDE

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora\_GDE' (Origin Key Attribute Field = [ESASstatus]) to 'tlu\_esasstatus\_GDE' (Foreign Key Attribute Field = [ESASstatus]).

#### 113] CoverCodes\_by\_Flora\_GDE

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora\_GDE' (Origin Key Attribute Field = [DefaultCoverCode]) to 'tlu\_covercodes\_TaxaFlora\_GDE' (Foreign Key Attribute Field = [CoverCode]).

#### 114] IUCN\_by\_Flora\_GDE

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora\_GDE' (Origin Key Attribute Field = [IUCNstatus]) to 'tlu\_iucnstatus\_GDE' (Foreign Key Attribute Field = [IUCNstatus]).

#### 115] NtnlConsStatus\_by\_Flora\_GDE

**Summary:** This relationship class creates a One to One relationship from 'tlu\_TaxaFlora\_GDE' (Origin Key Attribute Field = [NtnlConservationStatus]) to 'tlu\_ntnlconservationstatus\_GDE' (Foreign Key Attribute Field = [CastNtnlConservationStatus]).



#### 116] Sada\_Dist\_by\_Protocol\_Avalanche

**Summary:** This relationship class creates a One to One relationship from 'tbl\_SadaProtocols' (Origin Key Attribute Field = [AvalancheDisturbance]) to 'tlu\_sada\_disturbance' (Foreign Key Attribute Field = [distID]).

#### 117] Sada\_Dist\_by\_Protocol\_Fire

**Summary:** This relationship class creates a One to One relationship from 'tbl\_SadaProtocols' (Origin Key Attribute Field = [FireDisturbance]) to 'tlu\_sada\_disturbance' (Foreign Key Attribute Field = [distID]).

#### 118] Sada\_Dist\_by\_Protocol\_Flood

**Summary:** This relationship class creates a One to One relationship from 'tbl\_SadaProtocols' (Origin Key Attribute Field = [FloodDisturbance]) to 'tlu\_sada\_disturbance' (Foreign Key Attribute Field = [distID]).

#### 119] Sada\_Dist\_by\_Protocol\_Diversion

**Summary:** This relationship class creates a One to One relationship from 'tbl\_SadaProtocols' (Origin Key Attribute Field = [DiversionDisturbance]) to 'tlu\_sada\_disturbance' (Foreign Key Attribute Field = [distID]).

#### 120] Sada\_Dist\_by\_Protocol\_HorseBurro

**Summary:** This relationship class creates a One to One relationship from 'tbl\_SadaProtocols' (Origin Key Attribute Field = [HorseBurroDisturbance]) to 'tlu\_sada\_disturbance' (Foreign Key Attribute Field = [distID]).

#### 121] Sada\_Dist\_by\_Protocol\_Cattle

**Summary:** This relationship class creates a One to One relationship from 'tbl\_SadaProtocols' (Origin Key Attribute Field = [CattleDisturbance]) to 'tlu\_sada\_disturbance' (Foreign Key Attribute Field = [distID]).

#### 122] Sada\_Dist\_by\_Protocol\_Recreation

**Summary:** This relationship class creates a One to One relationship from 'tbl\_SadaProtocols' (Origin Key Attribute Field = [RecreationDisturbance]) to 'tlu\_sada\_disturbance' (Foreign Key Attribute Field = [distID]).



#### 123] Sada\_Dist\_by\_Protocol\_Dredging

**Summary:** This relationship class creates a One to One relationship from 'tbl\_SadaProtocols' (Origin Key Attribute Field = [DredgingDisturbance]) to 'tlu\_sada\_disturbance' (Foreign Key Attribute Field = [distID]).

#### 124] Sada\_Dist\_by\_Protocol\_Restoration

**Summary:** This relationship class creates a One to One relationship from 'tbl\_SadaProtocols' (Origin Key Attribute Field = [RestorationDisturbance]) to 'tlu\_sada\_disturbance' (Foreign Key Attribute Field = [distID]).

#### 125] Sada\_Dist\_by\_Protocol\_Other

**Summary:** This relationship class creates a One to One relationship from 'tbl\_SadaProtocols' (Origin Key Attribute Field = [OtherDisturbance]) to 'tlu\_sada\_disturbance' (Foreign Key Attribute Field = [distID]).

#### 126] Sada\_Dist\_by\_Protocol\_Drought

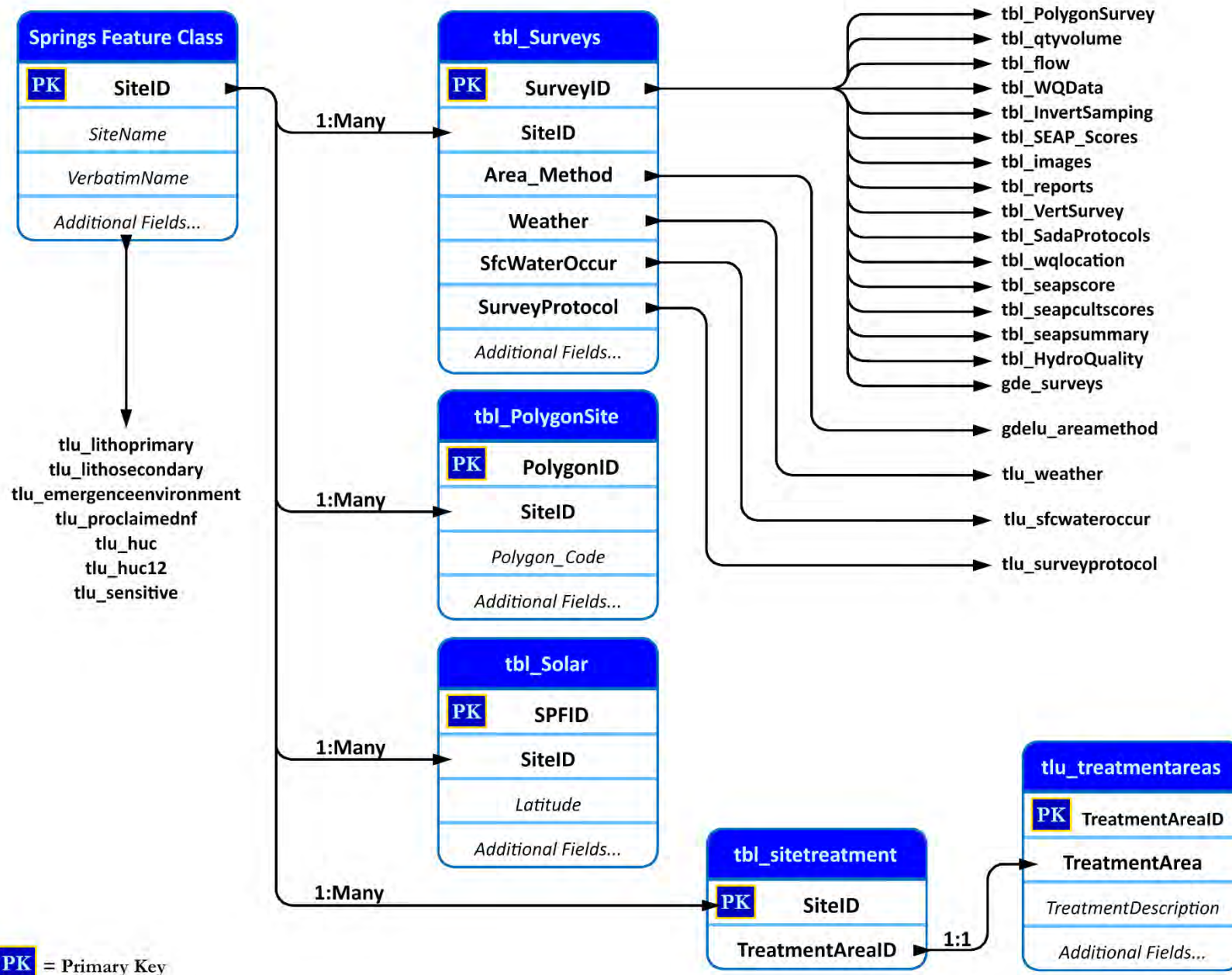
**Summary:** This relationship class creates a One to One relationship from 'tbl\_SadaProtocols' (Origin Key Attribute Field = [DroughtDisturbance]) to 'tlu\_sada\_disturbance' (Foreign Key Attribute Field = [distID]).

#### 127] Sada\_Dist\_by\_Protocol\_Residence

**Summary:** This relationship class creates a One to One relationship from 'tbl\_SadaProtocols' (Origin Key Attribute Field = [ResidenceDisturbance]) to 'tlu\_sada\_disturbance' (Foreign Key Attribute Field = [distID]).

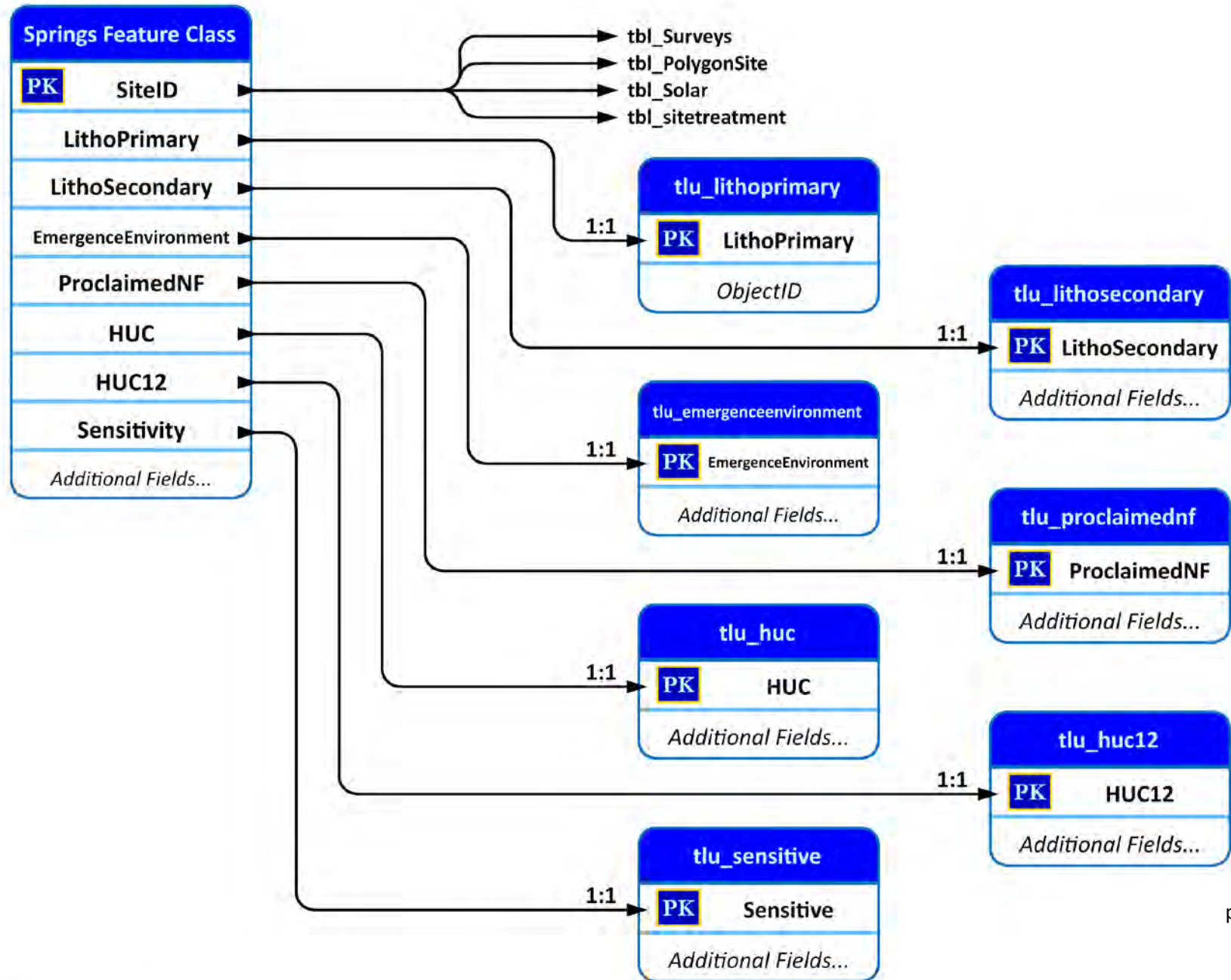
## Appendix B: Geodatabase Design

### Springs Feature Class and Descendents (1 of 2):





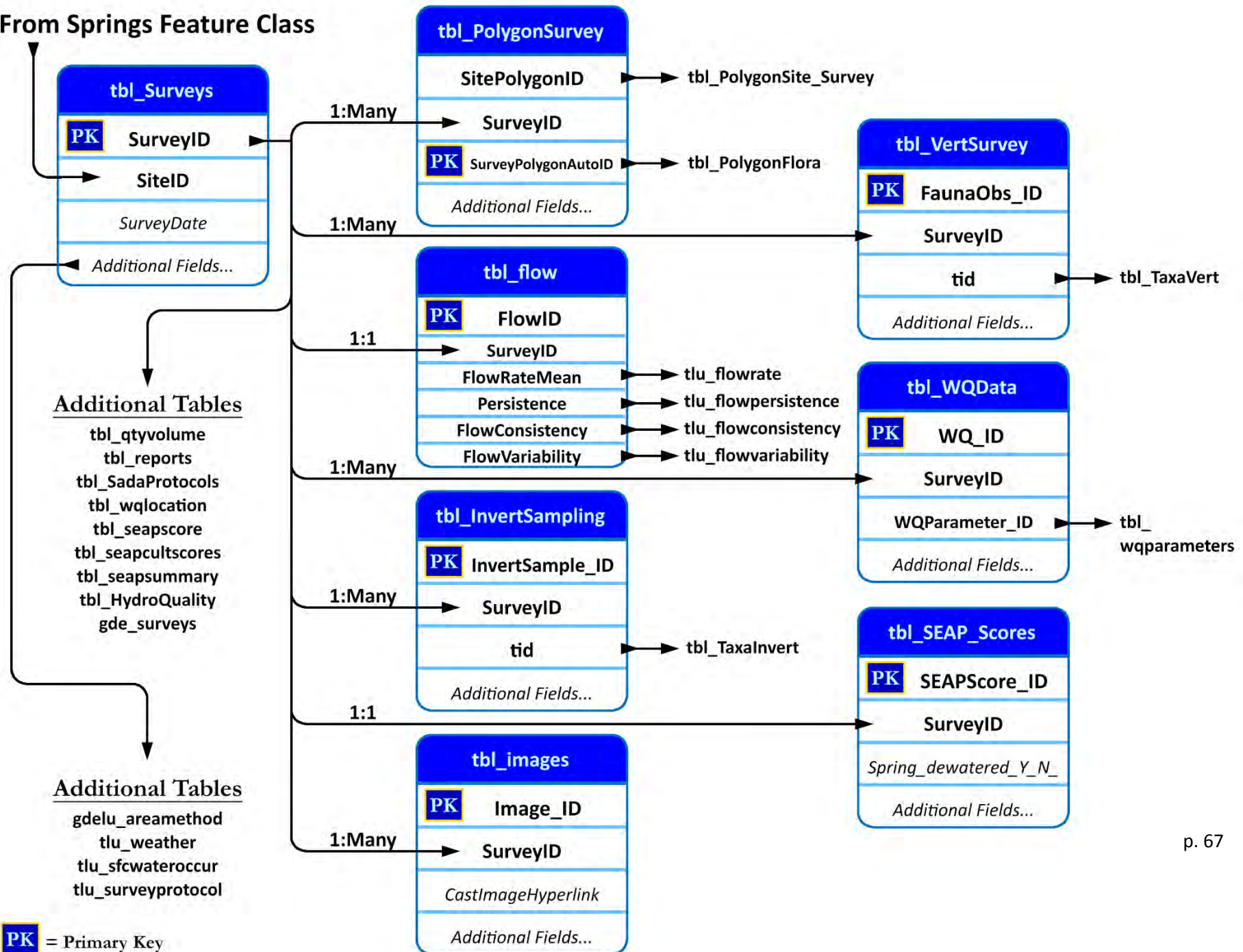
Springs Feature Class and Descendents (2 of 2):





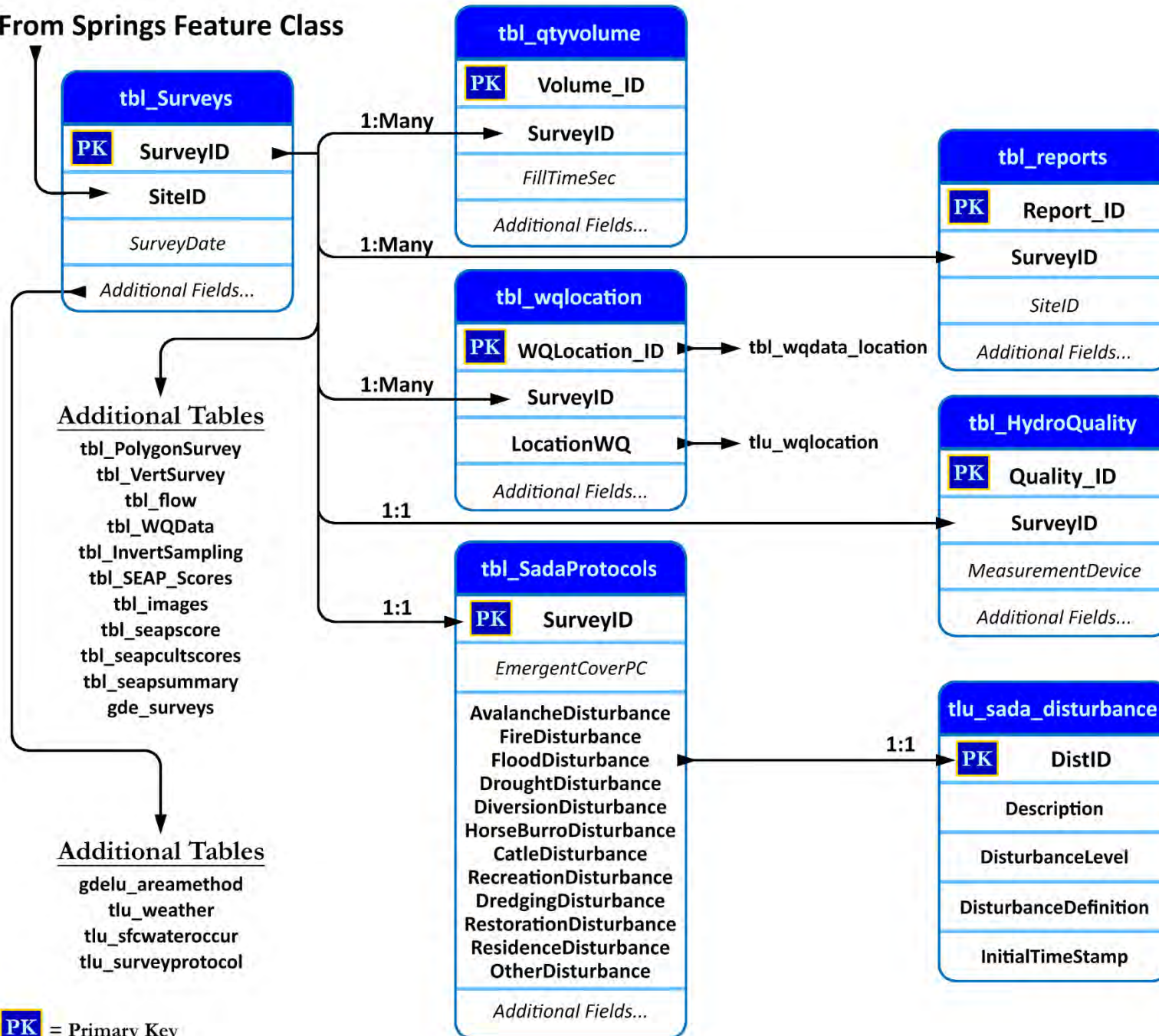
tbl\_Surveys and Descendents (1 of 4):

## From Springs Feature Class



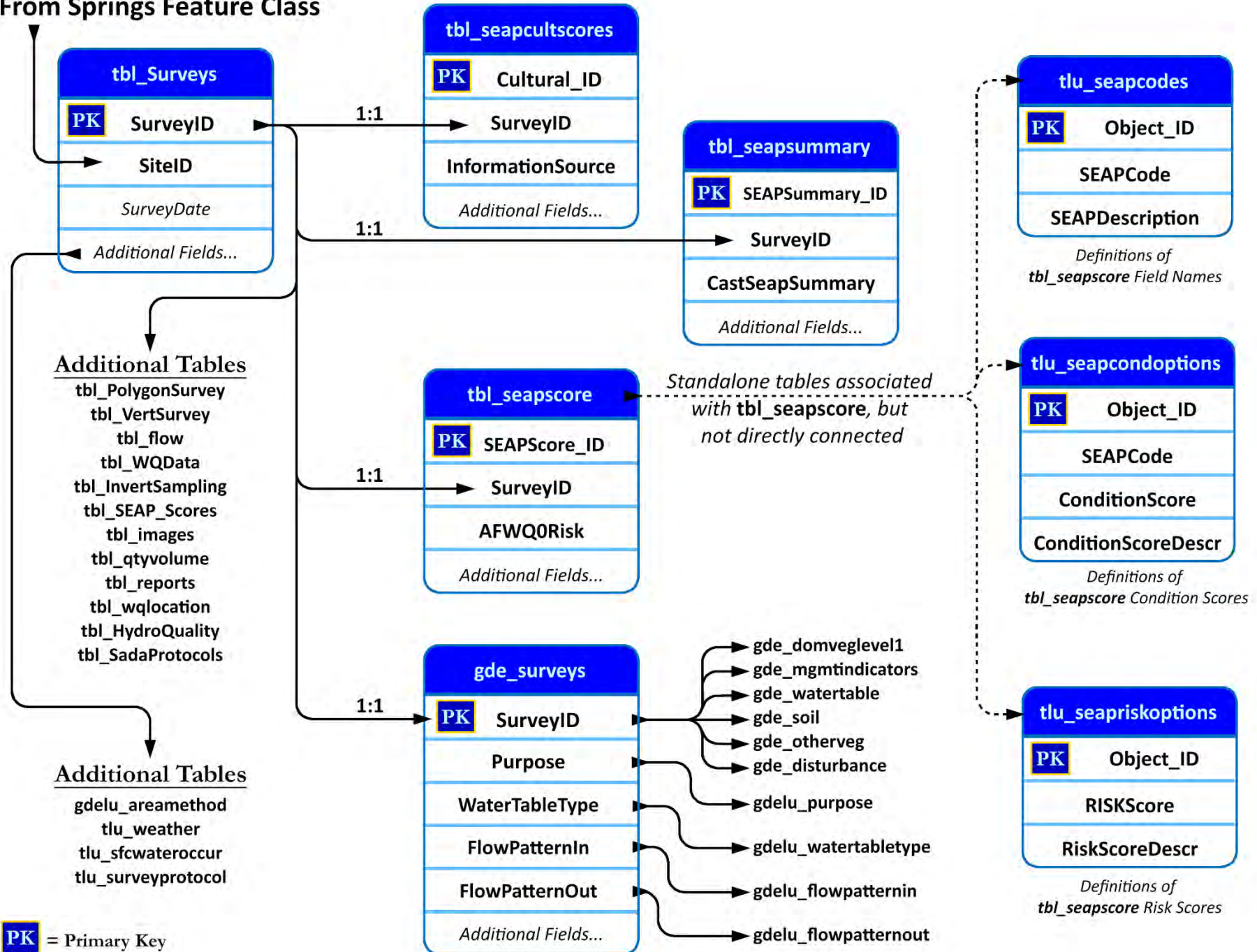
tbl\_Surveys and Descendents (2 of 4):

From Springs Feature Class



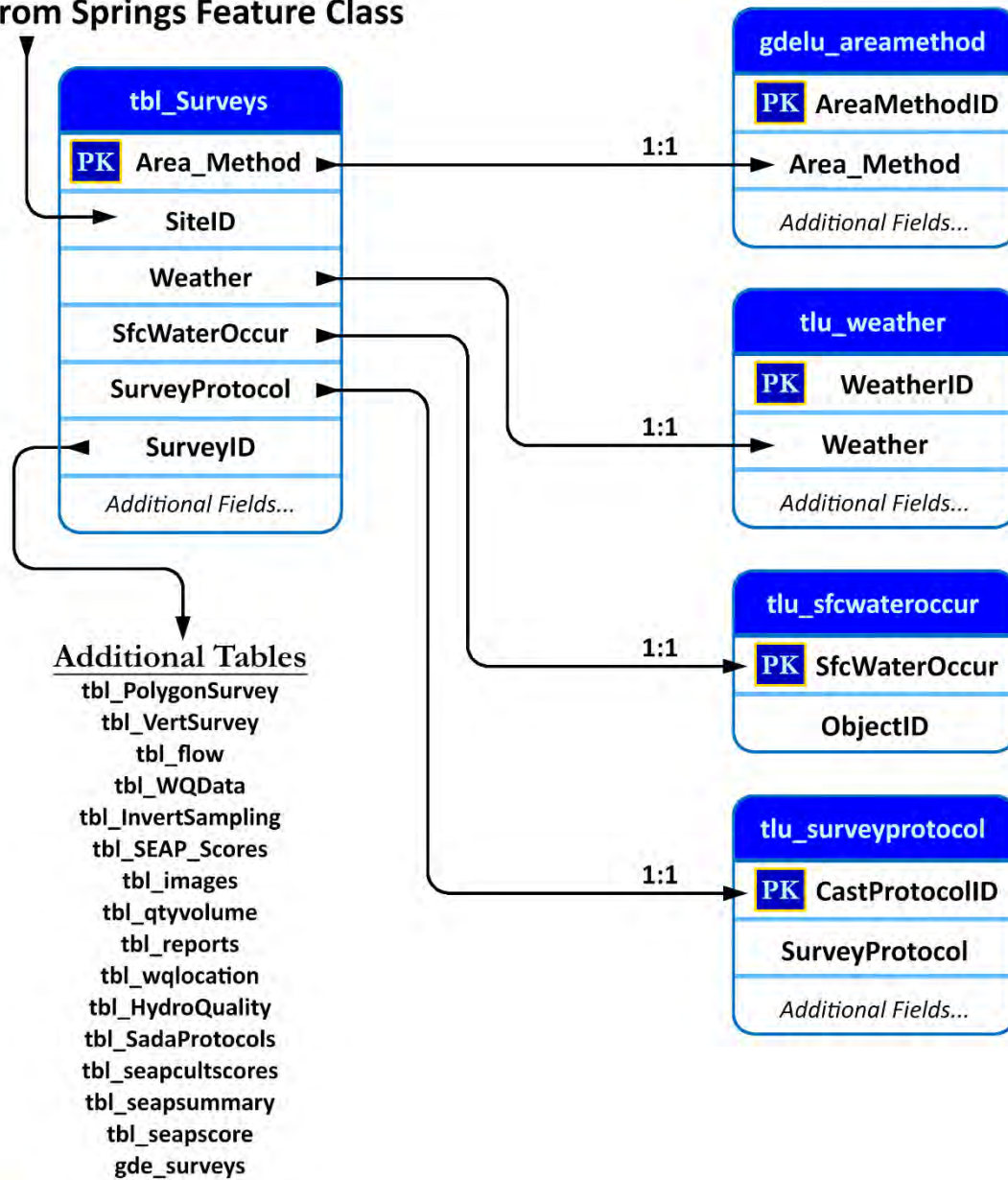


## From Springs Feature Class



tbl\_Surveys and Descendents (4 of 4):

From Springs Feature Class



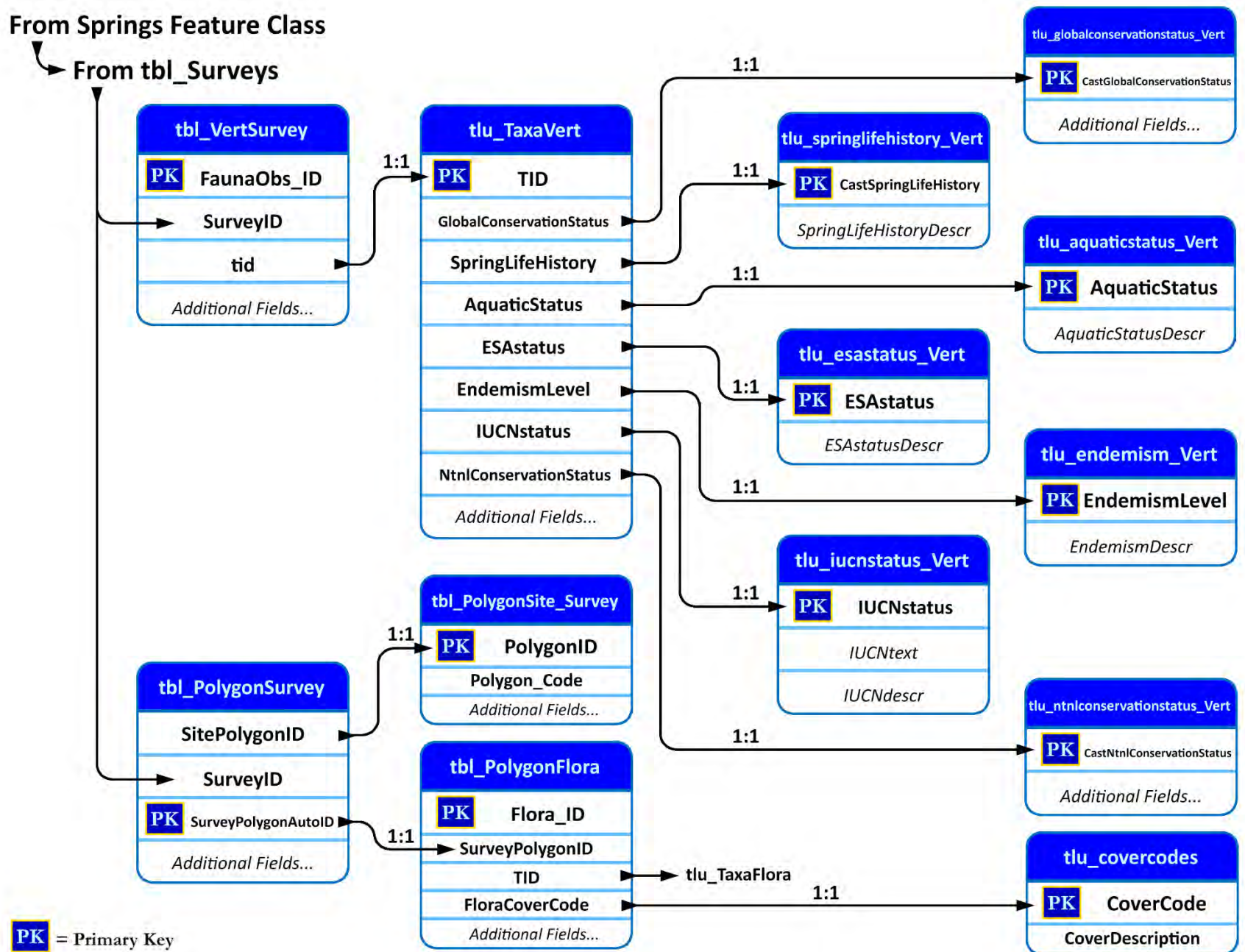
**PK** = Primary Key



tbl\_Surveys to tbl\_VertSurvey, tbl\_PolygonSurvey and Descendents:

From Springs Feature Class

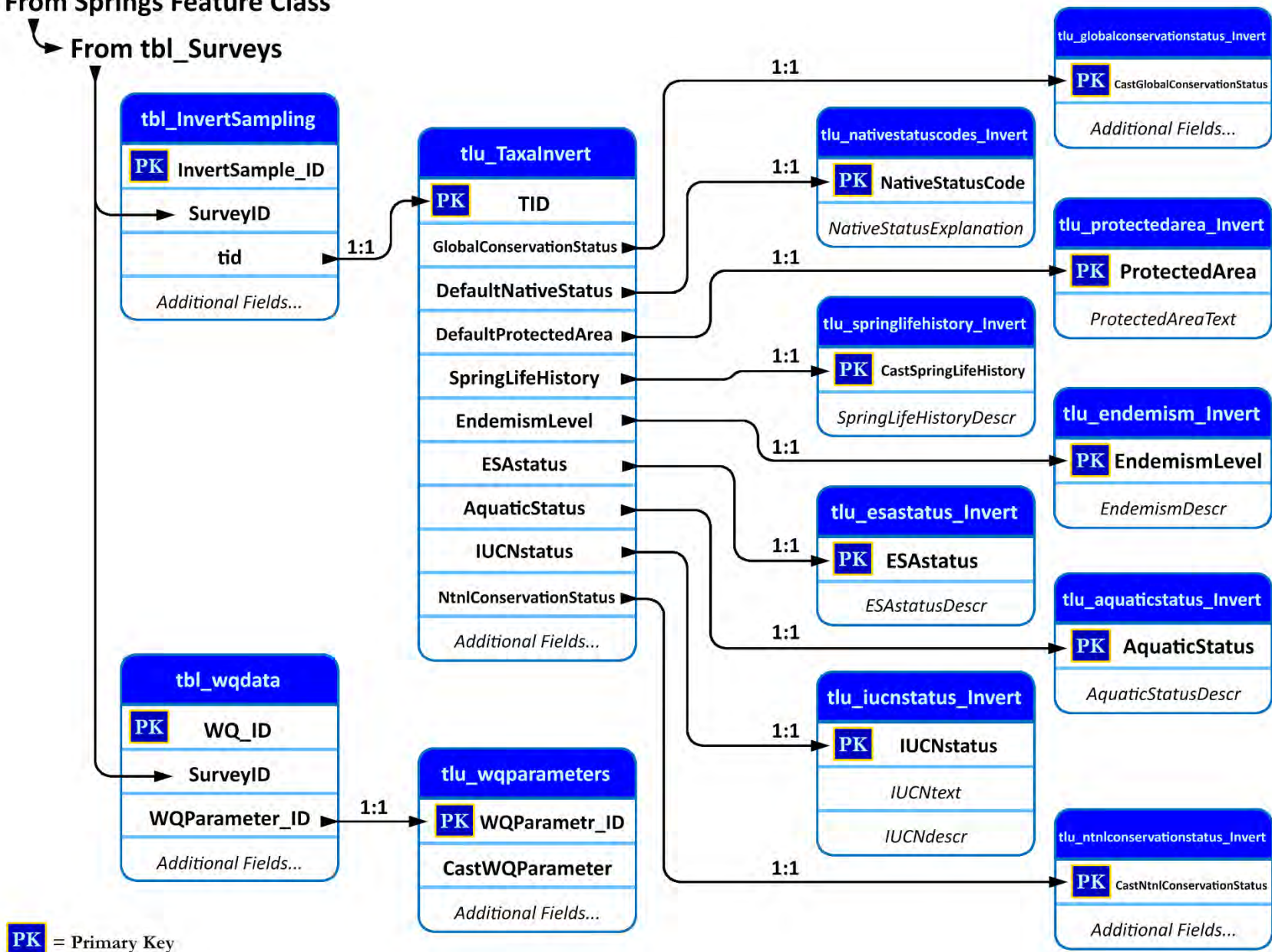
From tbl\_Surveys



tbl\_Surveys to tbl\_InvertSampling, tbl\_wqdata and Descendents:

From Springs Feature Class

From tbl\_Surveys

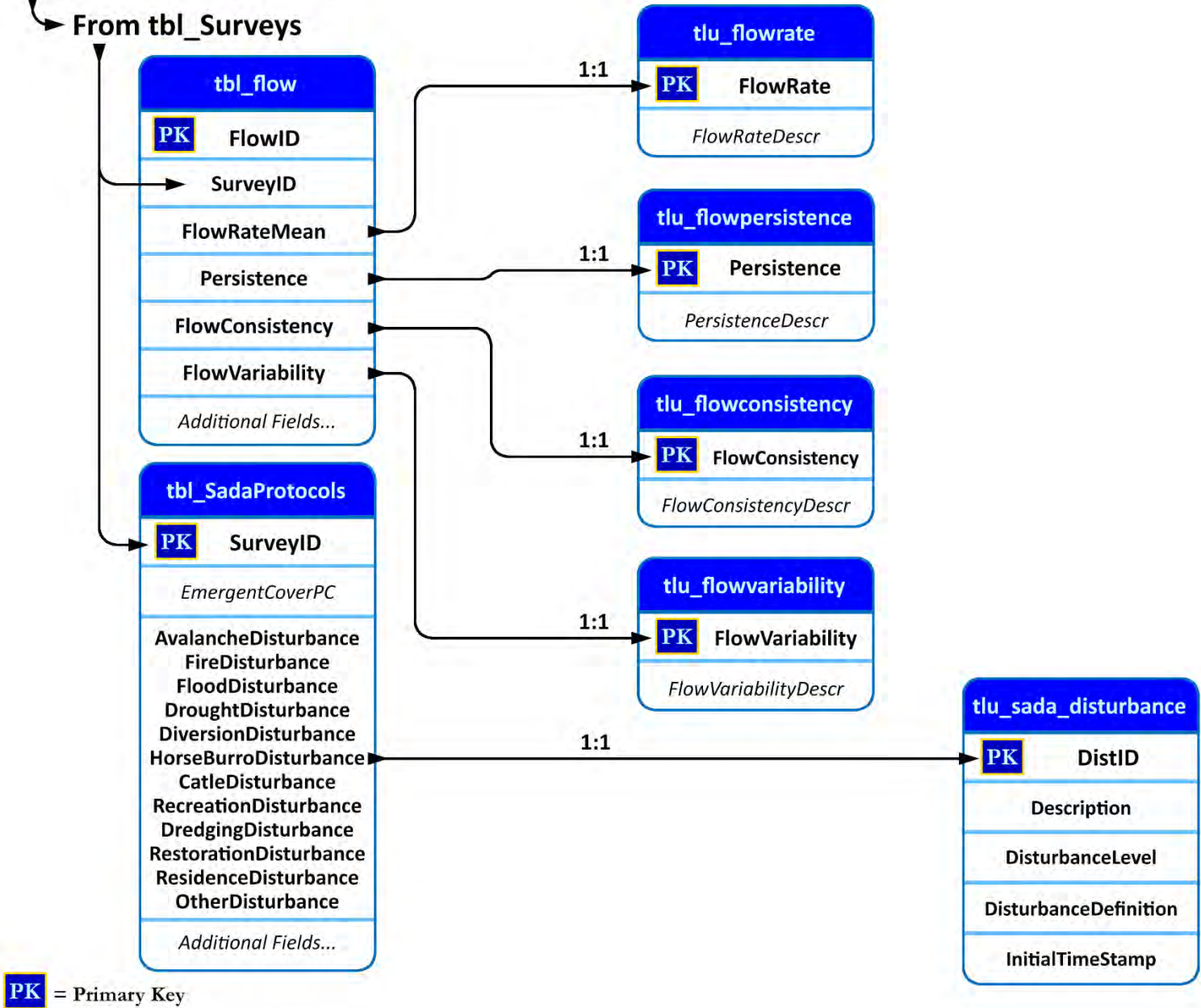




tbl\_Surveys to tbl\_flow, tbl\_SadaProtocols and Descendents:

From Springs Feature Class

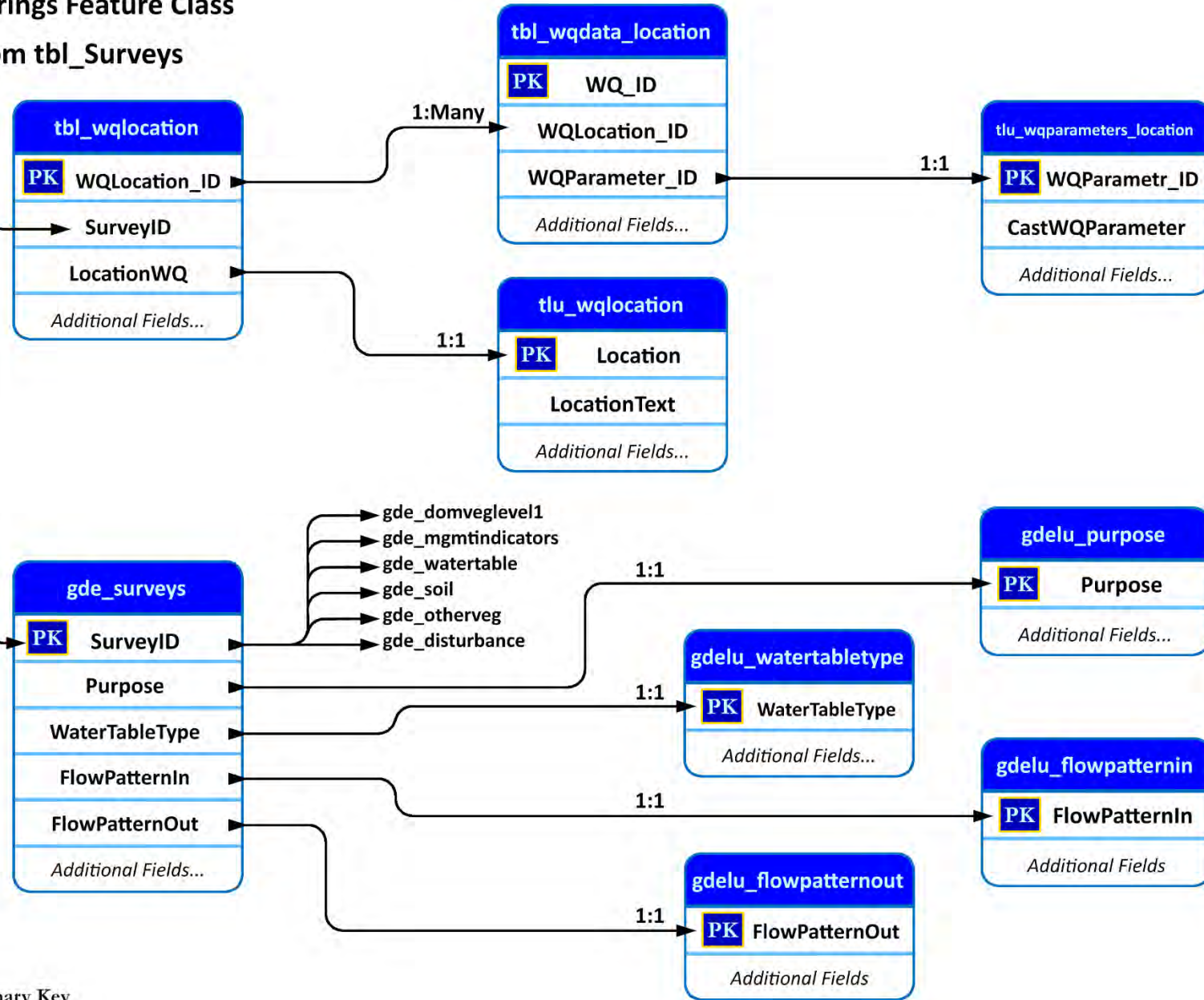
From tbl\_Surveys



tbl\_Surveys to tbl\_wqlocation, gde\_surveys and Descendents:

From Springs Feature Class

From tbl\_Surveys

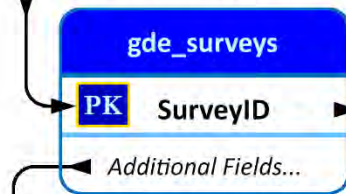


**PK** = Primary Key

From Springs Feature Class

From tbl\_surveys

From gde\_surveys

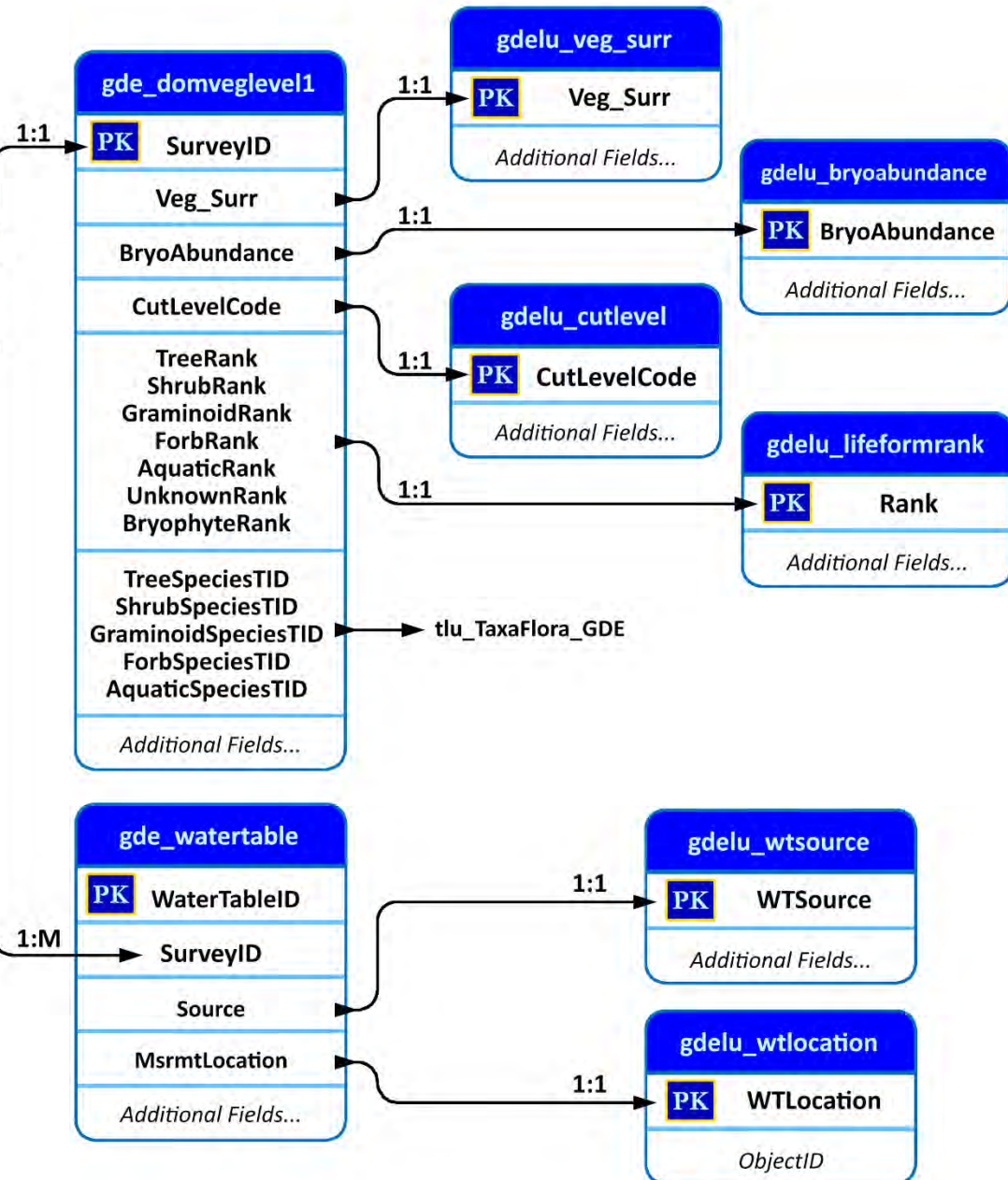


Additional Tables

gde\_mgmtindicators  
gde\_soil  
gde\_otherveg  
gde\_disturbance

Additional Tables

gdelu\_purpose  
gdelu\_watertabletype  
gdelu\_flowpatternin  
gdelu\_flowpatternout



**PK** = Primary Key

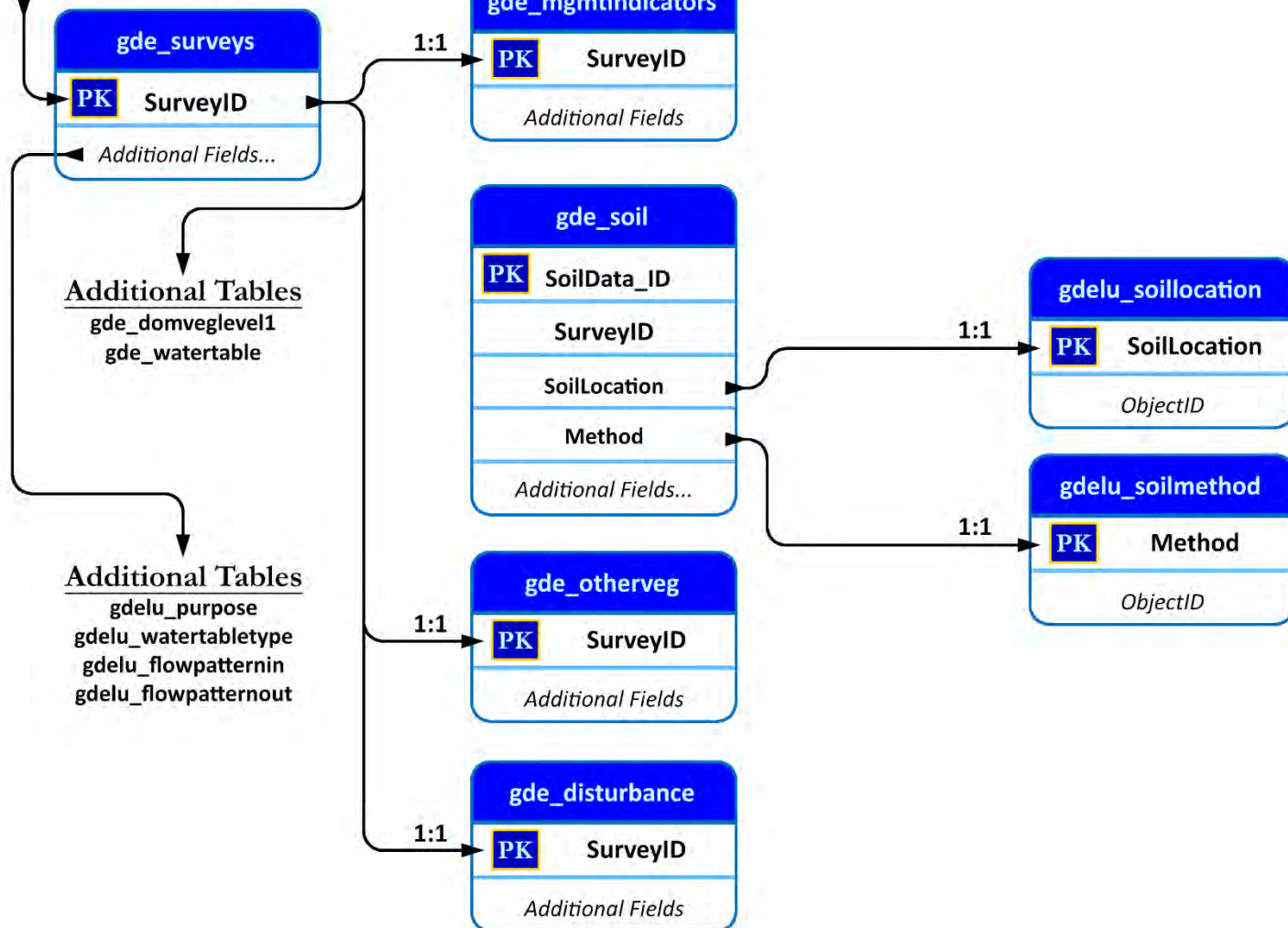


gde\_Surveys to gde\_mgmtindicators, gde\_soil, gde\_otherveg, gde\_disturbance and Descendents

From Springs Feature Class

From tbl\_Surveys

From gde\_surveys



**PK** = Primary Key

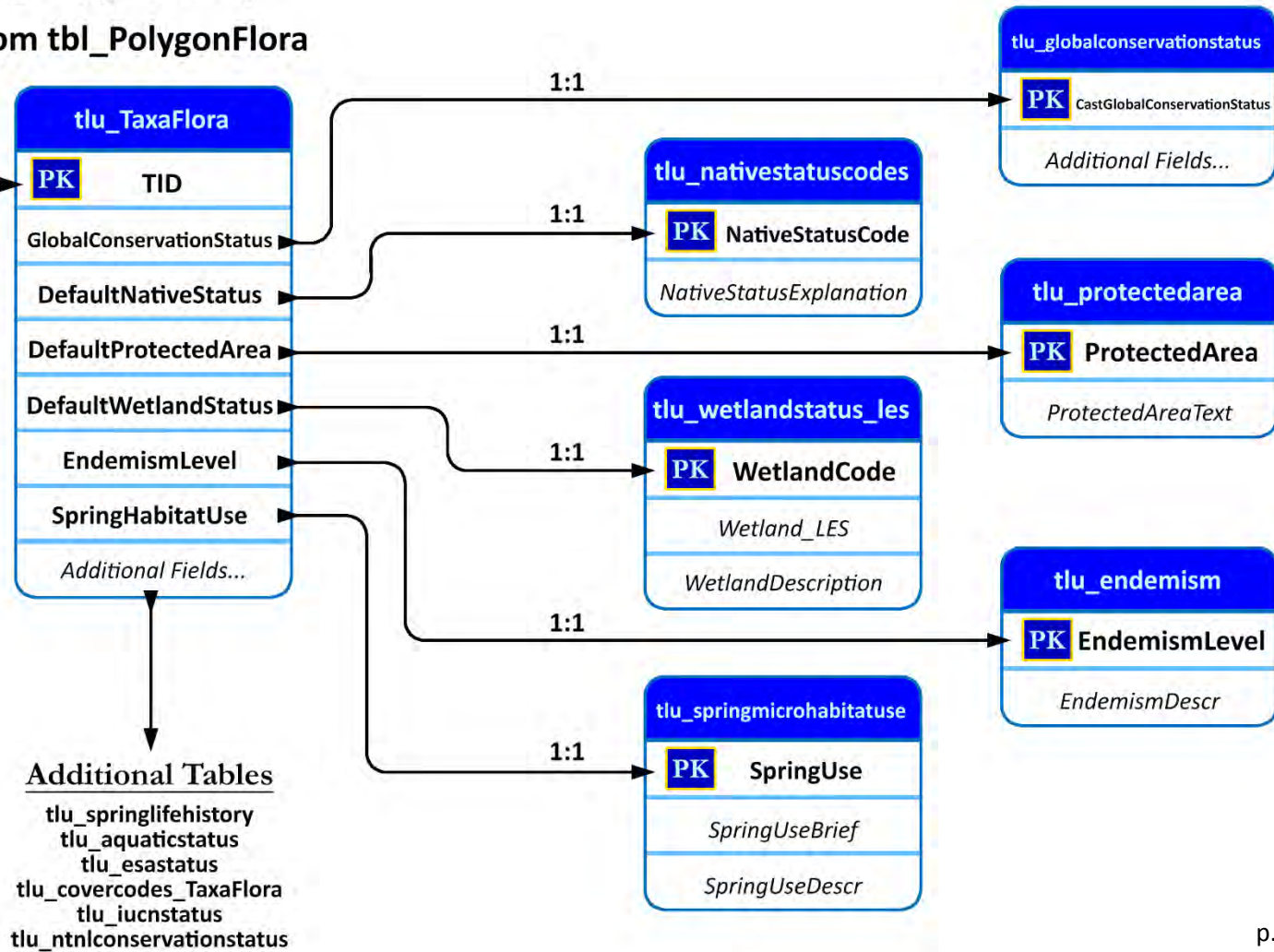
tlu\_TaxaFlora and Descendents (1 of 2):

From Springs Feature Class

From tbl\_Surveys

From tbl\_PolygonSurvey

From tbl\_PolygonFlora



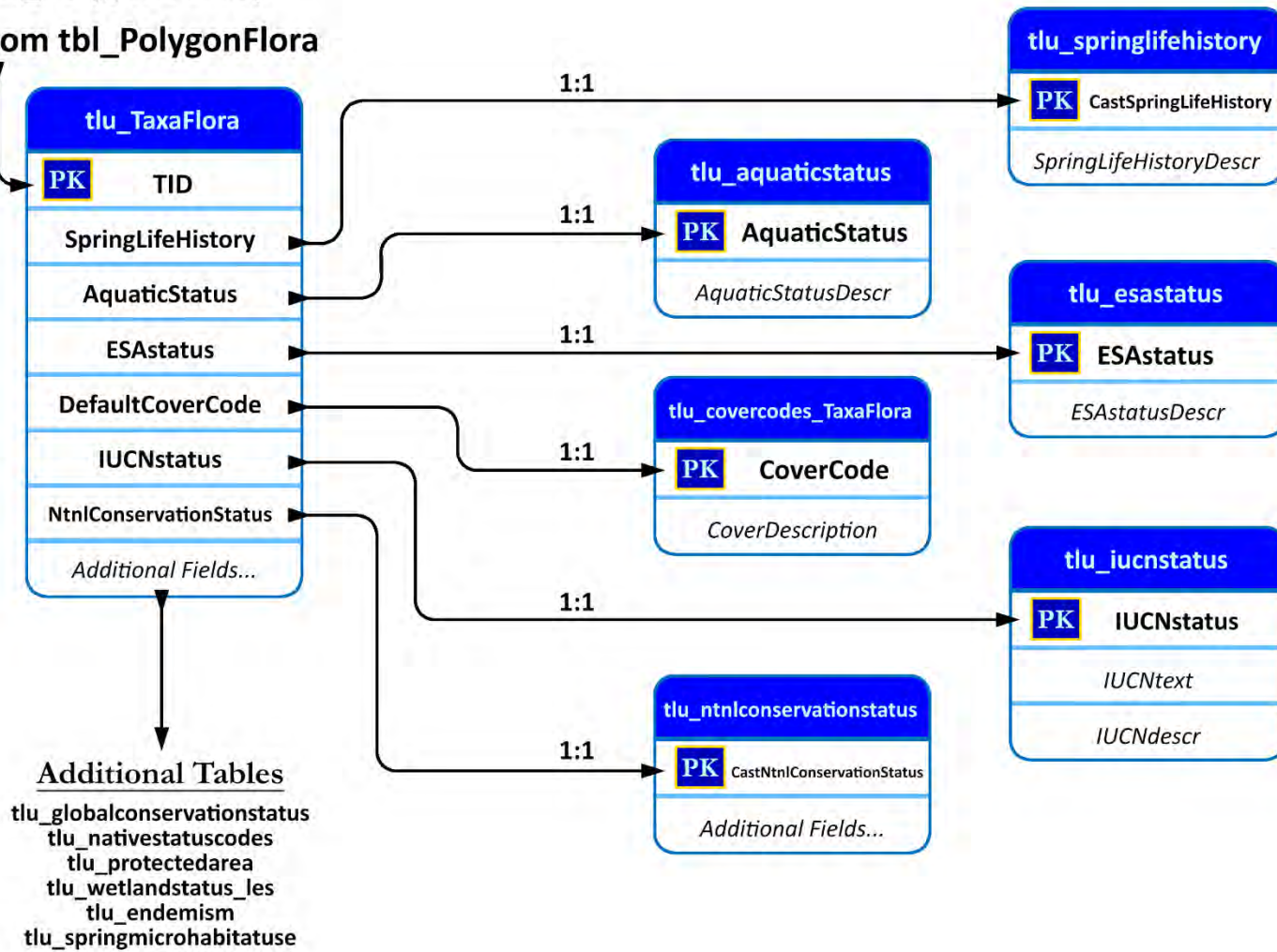
tlu\_TaxaFlora and Descendents (2 of 2):

From Springs Feature Class

From tbl\_Surveys

From tbl\_PolygonSurvey

From tbl\_PolygonFlora





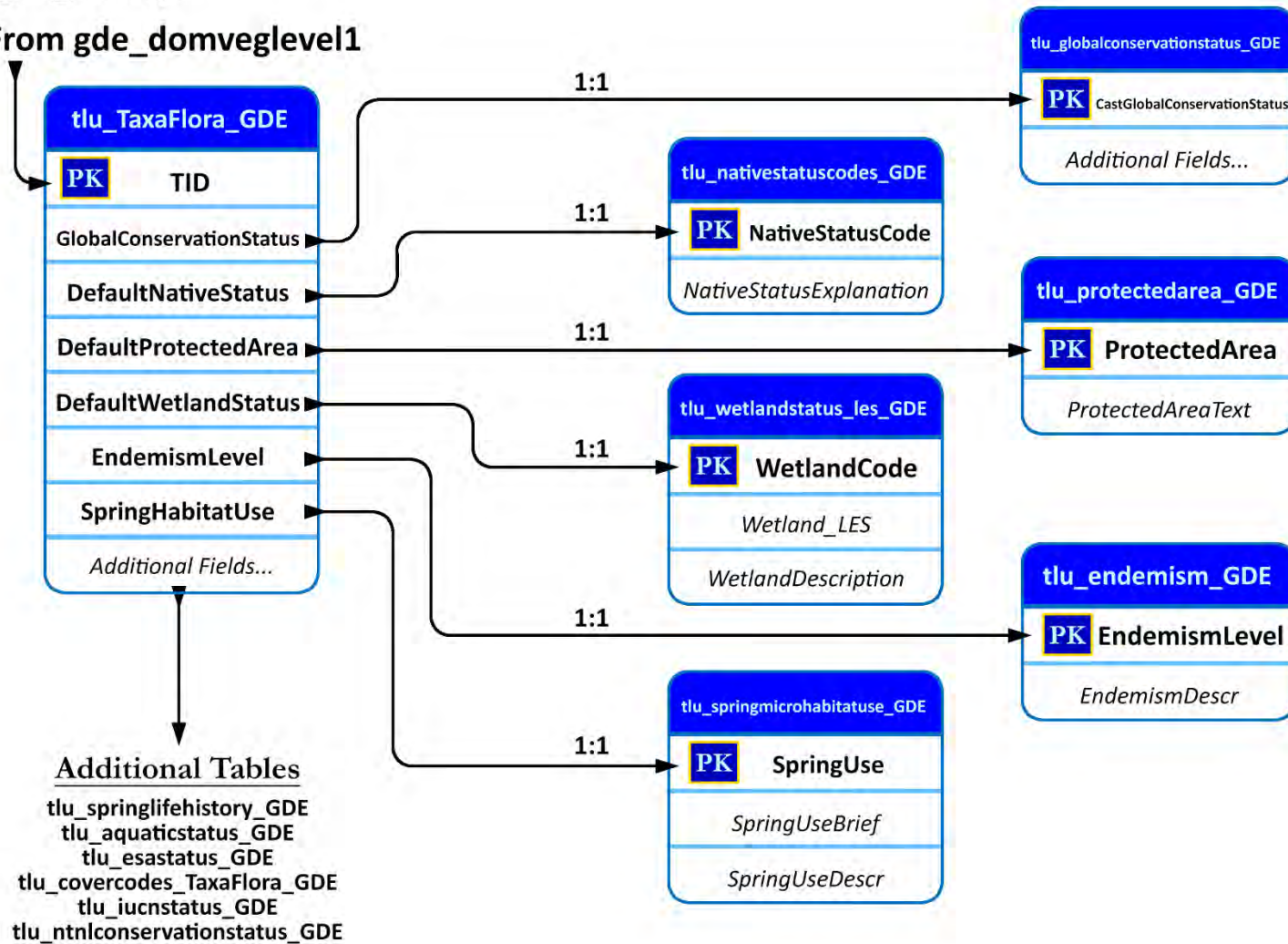
tlu\_TaxaFlora\_GDE and Descendents (1 of 2):

From Springs Feature Class

From tbl\_Surveys

From gde\_surveys

From gde\_domveglevel1



tlu\_TaxaFlora\_GDE and Descendents (2 of 2):

